FOOD AND AGRICULTURE ORGANIZATION
OF THE UNITED NATIONS

UNITED NATIONS
ENVIRONMENT PROGRAMME

EMASAR PHASE II

Volume V

GRASSLAND EDUCATION AND TRAINING

With special reference to arid and semi-arid zones of eastern and southern Africa

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

ECOLOGICAL MANAGEMENT OF ARID AND SEMI-ARID RANGELANDS IN AFRICA, THE NEAR AND MIDDLE EAST

(EMASAR Phase II)

Volume V

GRASSLAND EDUCATION AND TRAINING

With special reference to arid and semi-arid zones
of Eastern and Southern Africa

By

L.R.N. STRANGE

FAO Consultant on grassland education

Prepared as part of a cooperative project
of the United Nations Environment Programme
with the Food and Agriculture Organization
of the United Nations as cooperating agency.

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

Rome, 1978

The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

M-11

ISBN 92-5-100565-6

CONTENTS

ANNEXES

SUMMARY

This report, made following a visit to Kenya, Botswana and Swaziland in January 1977, has been prepared with a view to developing the regional and sub-regional strategy on information, education and training requested under the EMASAR Phase II Programme. 2/

The urgency of the present need for training in grassland 1/ production is noted, and the meaning and extent of this academic subject is defined. It is seen that land tenure, through its influence on control over both plants and animals exerts a profound effect on the use and management of grassland, resulting in a subject referred to as 'Grassland production' - of great breadth and complexity as it involves socio-economic and political considerations as well as a wide range of technical procedures.

A consequence of this situation is that technical education requires an African approach based on a new and independent philosophy , with curriculum subject matter content formulated to meet the urgent requirements of the developing countries. Much of the training given in 'Pasture production' or 'Range management' in other continents is irrelevant to the African scene.

Summaries of ongoing training programmes at all levels in Kenya, Botswana, Swaziland and Tanzania are described in separate sections referring to each country, with notes and recommendations made at the end of each country section.

It is thought that these four countries provide a sufficiently representative sample on which to base general recommendations for a 'strategy on training' for this region. In summary these are :

1. Because populations are doubling about every 25-30 years, time is not unlimited for education to produce some necessary changes in customary attitudes towards land use. There is an urgent need for large-scale training programmes in Africa now.

2. A new philosophy of training in grassland production appears essential with 'Africa-orientated' curriculum subject-matter, supported by relevant locally-produced training manuals.

3. While the importance of training at medium and lower levels is fully appreciated there appears to be a need for starting University courses at B.Sc. level, leading later to advanced degrees in this subject. It is considered to be of the utmost importance that future Government executive staff should receive a relevant 'Africa-based' training.

The opening of B.Sc. courses, in which Grassland production is a major subject is therefore strongly recommended for both Nairobi and Dar es Salaam Universities; and also at any other University within this region.

1/ Grassland (or pastureland or grazing lands) = the author has used the word 'pastureland' throughout to mean the production and management of both plants (grasses, forbs and bush) and animals. For the sake of uniformity, the term grassland has been substituted and means in its broadest sense, lands fit for grazing and browsing (Editor's Note)

2/ The present document constitutes volume VI of the series which have been produced under Phase II of the international programme for the "Ecological Management of Arid and Semi-Arid Grasslands of Africa and the Near and Middle East".

Volume I concerns pastoral development and extension in the Sahel
Volume II concerns grassland education and training in the Sahel
Volume III relates to important indigenous forage plants of dry tropical Africa
Volume IV relates to important indigenous forage plants of North Africa, the Near and Middle East
Volume V concerns education training in grassland production in parts of Eastern and Southern Africa with special reference to the arid and semi-arid areas.

4. The basic concept of supporting and working through existing educational institutions is endorsed. The possibility of recommending an International Institute for top-level training in this subject was considered but ruled out in favour of developing university training at the national level.

5. The stratification of national training institutions was noted and the importance of each level in filling its particular niche. The formal school education system and the post-school training system are presented diagrammatically to illustrate their interdependence, and to bring out the need for each and every level within the whole system.

6. The non-availability of 'African' technical literature is a major constraint to progress and an obstacle to teacher training and curriculum development.

A three-man 'Author-project' is proposed - starting with a two-year contract based either at FAO, Rome or in Africa: the purpose being to write up a series of training manuals (preferably in loose-leaf folder form), taking special account of the important socio-economic factors which govern the present use of traditional grazing lands.

7. Teacher training should be a top priority task. The shortage of trained and experienced teachers who have an understanding of pastureland use is a major obstacle to progress.

8. The essential relationship of grassland production and animal production in training curricula is emphasized.

The annexes include some suggested syllabus subject matter and a bibliography.

I. A GENERAL VIEW OF GRASSLAND EDUCATION

1. Terms of reference and procedures

This report has been prepared within the terms of the programme for the Ecological Management of Arid and Semi-Arid Rangelands in Africa, the Near and Middle East (EMASAR), which was established after consultations and a conference in 1974 and 1975.

The relevant paragraph of the project document relating to education states : (EMASAR Phase II)

"3.2.1.1 Strategy on Information, Education and Training

It is essential to develop a regional and sub-regional strategy on information, education and training, which has to be based on the countries' premise or government's request, and should be regarded as a fundamental input to all grazing land development projects and implemented in their context (see 3.2.1.2).

Furthermore, the strategy will be coordinated with:

- fellowship programmes for professionals in range management and "aménagement du territoire" (extension staff);
- regional or sub-regional training courses, as previously recommended in such meetings sponsored by UNESCO, FAO and UNEP, as the Sfax meeting held in 1975;
- the publication of a training manual;
- the publication of technical and extension bulletins "

Financial provision was made for a one-man mission to carry out a short tour to assess grassland education and extension programmes in Africa outside the Soudano-Sahelian zone. This was completed during January and February 1977. The countries visited were Kenya, Botswana and Swaziland. Tanzania was also included in the report, although not visited, since the author has had recent experience there. There was insufficient time to extend the tour to other countries. The places visited represent only a small sample which serves however to illustrate some of the problems and training approaches that are common - with variations - in many parts. It is hoped that information gained from current programmes in these countries, combined with information available from other sources, will have provided a sufficient basis for suggestions that may be at least partially relevant to Eastern and Southern Africa as a whole, and perhaps also further afield.

The itinerary is outlined in Annex 1.

The terms of reference were :

" - to survey the present education, training and extension organization at different levels in the field of pastureland production generally but particularly in the arid and semi-arid regions of Kenya, Botswana, Swaziland and Tanzania;

- to inventory the present availability of local technicians and manpower needs for future development from the standpoint of technical training needs;

- to obtain details of training curricula currently being used and to consider possible ways in which these might be improved both in regard to principal courses at the different levels and 'in-service' refresher courses related to arid and semi-arid pastureland management;

- to observe present and intended programmes for teaching pastoralists and farmers at the "Rural training school" level, and to note possible improvements where these may be appropriate;

- to survey extension procedures, with special regard to radio broadcast education programmes for pastoralists;

- to review the situation concerning presently available "Africa-orientated" literature for training and extension in pastureland education;

- to note in general terms what additional building and servicing may be required for an increased pastureland management education input and to record approximate cost estimates."

The term grassland - which includes both grazing and browsing plants - is used here principally in connection with permanent pasture (range) and in the arid and semi-arid regions since these are the main concern of the EMASAR programme, but it also is used to include all other areas of vegetation either natural or planted, which can be grazed or browsed by domestic or wild animals. The arid and semi-arid zones are characterized by a mean annual rainfall of less than about 600 mm which is generally too low for reliable permanent agriculture.

The procedure followed during the work has been:

- first, to try to ascertain as accurately as possible what is the current thinking, planning and action in regard to pastureland training in each of the countries visited;

- second, to record details, especially details of training curricula, so that each might benefit from the experiences, ideas and approach of others to common problems;

- third, to offer tentative suggestions where it appears that improvements could be made within the framework of existing national policies, and

- fourth, to draw some general conclusions.

2. The background scene

The following statement is recorded in the EMASAR report of 1974 (2):-

" over much of the range area of Africa, the increasing concentration of people and livestock on a declining range resource has led to the breakdown of systems of pastoralism which previously had maintained some degree of equilibrium in the ecosystem. More often than not, attempts at alleviation - particularly water development and veterinary measures - have provided no more than a temporary palliative and have aggravated the overall decline. Generally, it has not been a shortage of investment funds which has held back or distorted range development, so much as deficiencies in planning and execution. On present performance, we have

listed the five commonest causes of failure :

(i) absence of a clear national commitment or strategy for range development, often associated with policies or legislation which inhibit rational development, e.g. in respect of land reform;

(ii) lack of information or understanding concerning ecological potentialities and constraints and socio-economic conditions and strategies, leading to unworkable projects, e.g. by attempting settlement where nomadism is an ecological necessity, misjudging livestock-carrying capacity, attempting range improvement where overpopulation precludes success, or disrupting viable social territorial units;

(iii) unbalanced development, as when new water supplies are installed without regard for other inputs (e.g. marketing) or adequate management, stemming usually from lack of understanding of the pastoral ecosystem and the complementarity of inputs;

(iv) lack of adequate organization in the National Government for the planning, direction and coordination of range development with deficiencies in staff, both in numbers and training, and

(v) inadequate local participation and organization at the level of the pastoral community, thereby depriving the people of incentive and means to contribute positively to the development process."

This statement has been repeated here since it illustrates a part of the background against which grassland training should be viewed. It indicates in some measure the magnitude and complexity of the problems that must be faced. It also suggests some broad objectives of education, which should have as its primary aim the preparation of the people of each country to understand, face up to and overcome the underlying causes of deterioration which have led to ruin of the resources of many of the drier parts of Africa. Unless the causes of lack of progress and of failure in affected areas are dealt with - and the only hope of achieving this quickly enough is through education of administrators, technicians and people on a large enough scale - the present waste of irreplaceable resources will accelerate. As a general rule therefore, those factors which are blocking progress and causing deterioration - especially the overruling socio-economic factors affecting communal (tribal) grasslands - should be given special emphasis in training curricula wherever these are relevant.

Much of the great economic potential of the permanent grazing/browsing areas in the region is at present frozen through inefficient land use which is by no means always the fault of the pastoralists themselves. Some of the national statistics summarized in sections II to V serve to illustrate the importance of these areas and the need for adequate education at all levels.

The following data, published by the Animal Production Research Unit in Botswana (12) give an idea of the improvements that may be expected when a change is made from traditional stock raising on communal grazing lands to a ranching system in which controlled stock populations can be properly fed on well-managed pastures. These results are thought to be typical of the increases that might also be expected in many other parts of Africa, although they should be interpreted with caution outside Botswana especially as the relative stocking rates are not mentioned.

TABLE 1 - PRODUCTIVITY UNDER CATTLE POST AND RANCH PRODUCTION SYSTEMS - BOTSWANA

Trait		Cattle post	Ranch
Calving percentages	%	46.4	74.0
Calf mortality	%	10.2	8.5
Weaning percentage	%	41.7	67.7
Weaning weight	kg	122.5	177.4
Post-weaning gain (7-18 months)	kg	84.1	100.5
Weight of weaner calf per cow per year	kg	51.1	120.1
Weight of 18-month calf per cow per year	kg	86.1	188.2

(Data obtained by the continuous monitoring of samples in representative areas. 'Cattle post' is the term applied to a permanent water source, such as a borehole, which may either be used by a community of stock owners, or a single owner, to provide for animals under the traditional unmanaged system of land use).

The results show that calving percentage is the outstanding factor.

Improvements such as these, on a national scale, involve not only better pasture management but also radical changes in land use, stock ownership and other important aspects of pastoral life. The difficulties of bringing about fundamental changes in social structure are great but the rewards are enormous; and time is limited before population expansion in many parts precludes effective action. Populations are now doubling roughly every 30 years and the time factor, already stressed by others, is again emphasized here. The purpose of training is development, but it loses much of its point once pasture/stock-dependant human populations exceed the support capacity of their land; creating an ecological-socio-economic and political situation which largely paralyses effective action.

Sound procedures can only be introduced by well-trained local technicians and extension workers of various grades as the agents of change, supported by research and where necessary by experience from external sources. To be effective, improved techniques should be understood and accepted by a majority of the rural people themselves. Experience suggests that changes in long-established traditional attitudes - where necessary - may not be forced by a minority if they are to become permanently established, but should as a rule be acceptable to the majority. This calls above all for thorough locally-orientated training of teaching staff, administrative,extension and research personnel, followed by education and extension effort amongst the pastoral peoples on a massive scale.

The report of the 1974 EMASAR Consultation states (2) :-

" The education field is very wide, covering :

- staff training at all levels (including University);
- primary and secondary schooling;
- adult education for pastoralists;
- programmes to increase public awareness."

" Staff training must begin with a manpower and organizational plan. A Range Department will require staff with capabilities (a) to plan and coordinate development programmes, (b) to manage and administer rangelands, (c) to study and evaluate effects of programmes, and (d) to assist graziers through extension network to apply new technologies and adopt more adequate forms of organization. A total range development programme will require, in addition, staff trained in water development, animal health and marketing and education and several other fields. Research staff will be needed in a variety of disciplines. Numbers and levels of training will need to be decided in each category."

" So far as possible, training should be based on existing facilities. It takes time and money to build new institutes."

The report also states, inter alia, that "emphasis is needed on action, (a) to stop deterioration and (b) to introduce sustainable systems of land use."

Although the present mission has necessarily been concerned with a large amount of detail, it is important to keep in mind that successful education should lead to the effective action emphasized by the EMASAR Conference.

3. The meaning and extent of education in grassland production

If training is to be organized to meet the needs of the "total range development programme", referred to in the EMASAR report, it will require a broad view. It is therefore perhaps necessary first to define the meaning and scope of 'grassland production' as used in this report and in the context of education; since opinions differ widely as to its scope and meaning.

The expression range management, adopted from North America, has become used in parts of Africa to include all aspects of integrated development and management of grazing lands and animals, from areas of communal (tribal) pasture use through to fully developed commercial ranching. Governmental Departments of Range Management where already established, have responsibility for much of this development work, especially within the arid and semi-arid environments. In some areas of Africa, range management has a rather restricted meaning; often being limited in reference to the drier environments and sometimes merely to plant management.

The general term **Grassland Production** is used in preference to Range Management in this report since it suggests the production and management of both plants (grasses, forbs and bush) and animals, and encompasses as well the communal pastures of the higher rainfall areas and wet-lands. These latter contribute very significantly to livestock economies and must be included in the comprehensive teaching of this subject,

even though the arid and semi-arid zones may be primarily in view.

When grazing lands are looked at broadly in the context of land use, it is seen that there are often no sharp divisions between the zones comprising the whole ecological spectrum from humid farmland to arid pastureland, and the rather arbitrary distinction between 'range' and other areas sometimes made in Africa, is often inappropriate and undesirably restrictive. Rather, there is usually a gradual transition from one zone to another in which livestock become economically more important in comparison with agricultural and plantation crops, as rainfall decreases.

The accompanying summary of land use (Table 2) is included here to illustrate the extent and complexity of grassland production as an academic subject when taking a broad view of relationships between environment, pastures and animals.

For this illustration, the ecological spectrum has been divided into four rainfall zones and subdivided into two major land use categories, all of which are typical of many parts of Africa. The two categories of land use systems (each containing many variations) profoundly influence pasture/animal production through their effect on animal control. Successful management is impossible without integrated control of animals, plants and other ecosystem components, under the same authority, i.e. effective in reality and not just in intention. The two categories described here differ greatly in that regard: one representing those forms in which proper use is not possible and in which deterioration is, therefore, most likely in the long run and the other representing those forms in which proper use is possible and in which there is a potential, though often not fully exploited, for development to the fullest extent of environmental capability by intensive management.

In order to distinguish between each, these two categories have been described for training purposes as : -

Uncoordinated use,[1/] in which management authority over livestock (primarily stock numbers and secondarily stock movements) is not fully integrated with authority over the pastureland.

Nearly all of the traditional stock raising regions of Africa come into this group in which the animals are directly controlled by individuals who have no personal responsibility for their grazing lands. In these circumstances, there is a natural tendency for stock owners to maximize their flocks and herds in competition with neighbours regardless of grazing capacity. Conditions vary greatly however. In some parts of Africa insecurity of tenure has the same general effect amongst tenant farmers.

Control of stock numbers is automatically resisted by people whose daily life, status and social organization largely depends on the possession of wealth in the form of animals.

Management procedures in this category are therefore much restricted by social considerations and little can be achieved without the willing cooperation of a majority of the people. Absence of any form of boundary control in the grazing lands is generally characteristic.

1/ The author refers here to East Africa; traditional livestock production makes frequently the best(and only) use of African dry lands where grazing is limited to a fraction of the year and follows erratic rains; it is also the major purveyor of meat in Africa (Editor's Note).

Coordinated use, in which control over all the ecosystem components is fully and effectively integrated under the same management authority having security of tenure; whether that authority is the state, a body of people acting in committee, or a single owner.

Most commercial ranches 2/ come within this group and boundary enclosure or other easily recognized delineation against trespass is generally characteristic. Management procedures are usually less involved with the complications of human society and more efficient and sophisticated techniques which depend on close control can therefore be adopted freely with little or no reference to social considerations.

The dividing line between these two categories is rather distinct and their effect on the land is often clearly evident in agriculturally deveoped areas. Basically the difference between them is that given fully integrated management there is a potential to achieve proper use, and maximum animal production, while without it there is not. For practical purposes, the two categories divide on the issue of stocking rate and animal control. Without ecologically unified management, it is generally not possible (because of social opposition) to achieve a safe balance between forage production and feed consumption through direct manipulation of animal numbers and season and intensity of use, though indirect measures can sometimes partially help. Whereas under a coordinated authority, this essential balance can be maintained by direct adjustment of the stocking rate to grazing capacity and by following well-established management procedures. Integration of resource control under the same authority does not of course, in itself, guarantee success. It merely opens up the possibility of proper use, under trained management. Without managerial knowledge and understanding pastureland may still be (and often is) mismanaged despite coordination of responsibility. Likewise, it should also be pointed out that traditional pastoralism (uncoordinated use) is by no means wholly inefficient. On the contrary, in some respects it may be highly efficient in spite of its ecological weakness under pressure from expanding populations; such as its thorough use of herbage through mixed stocking, and in the often skilful management of animals by stock owners, and in observing ecologically desirable seasonal movements.

Many of the current development programmes, such as "group ranches", grazing blocks and "grazing cooperatives" have been designed to encourage a shift by pastoralists away from traditional uncontrolled communal use, which tends to be wasteful and self-destructive under growing population pressures, towards more controlled forms of use under the authority of management committees elected by the groups of participants. They are also designed to create more favourable conditions for the injection of capital. Provision for control of stocking rates is generally an important part of plans, but is very difficult to implement. A characteristic of these improved forms of land use (which may perhaps be regarded to some extent as transitional between the two main categories) is that groups of stock-owners cooperate by accepting common boundaries, facilities and administration but retain individual ownership of livestock. The acceptance of management control over animal movements usually presents few problems but acceptance of control over stock numbers is in most cases a main difficulty - understandable from the viewpoint of the owners. This difficulty often bars the way towards fully integrated management and sound economic development, since if the stocking rate is too high, management is impossible. This basic principle cannot be disregarded!

2/ The author bases his case on successful and well-balanced ranching activities. Examples exist in Africa of state ranching difficulties, and in commercial ranching the long term conern for environmental protection is not always a major operational factor (Editor's note).

TABLE 2 - A SIMPLIFIED SPECTRUM OF LAND USE ILLUSTRATING THE INFLUENCE OF RAINFALL AND LAND USE SYSTEMS ON CROPS, PASTURES AND ANIMAL PRODUCTION

HUMID (Economically intensive) — RAINFALL — ARID (Economically non-intensive)			
FARMLAND		RANGELAND	
AGRICULTURAL ZONES (Approx. 750 mm and over)	AGRIC./PASTORAL ZONES (Approx. 500-750 mm)	DRY PASTORAL ZONES (Approx. 250-500 mm)	SEMI-DESERT PASTORAL ZONES (Approx. less than 250 mm)
UNCOORDINATED USE: MAINLY SUBSISTENCE ECONOMY BUT CASH SALES ALSO IMPORTANT			
Largely subsistence agriculture in fragmented holdings in which cash crops and food crops are individually owned and sometimes enclosed but surrounded by unmanaged common pastureland.	Smaller areas of cropland in relation to larger areas of communal grassland or bushland. No enclosure of grazing areas. Enclosed cultivation in some parts.	Relatively small areas of individually owned crops (often very poor) within a mainly pastoral environment where emphasis is on stock raising on "common pastureland".	Traditionally nomadic and transhumant subsistence pastoralism; but with increasing modern tendency towards settlement near permanent water in some countries.
No enclosure of pastures, and no cultivated pastures used. Residues of food crops fed to stock in dry weather. Continuous maximum stocking pressure a common feature on severely over-grazed and degraded pastureland in areas of high stock concentration; but abundant unused forage in other parts where, because of tsetse fly or other causes, stock concentrations are low.	Economy often about equally balanced between crops and stock. Predominantly over-grazed pastures under continuous maximum stocking pressure in accessible localities that are free from tsetse fly or other inhibiting factors.	Generally widespread evidence of deterioration; bush encroachment and soil erosion in many parts where conditions favour large concentrations of animals, especially near permanent water. No enclosure of grazing areas. Although much meat is used for subsistence considerable quantities are marketed. Many of the people follow a nomadic or transhumant tradition.	Range pastures generally in various stages of retrogression due to overstocking especially in areas which favour human habitation and animal concentrations near permanent water. Extensive denudation, advanced wind and water erosion, devastation in many places. Recurrent famine and impoverished people a common feature.

TABLE 2 (cont'd)

HUMID (Economically intensive) — FARMLAND		RAINFALL	ARID (Economically non-intensive) — RANGELAND	
AGRICULTURAL ZONES (Approx. 750 mm and over)	AGRIC./PASTORAL ZONES (Approx. 500–750 mm)		DRY PASTORAL ZONES (Approx. 250–500 mm)	SEMI-DESERT PASTORAL ZONES (Approx. less than 250 mm)
COORDINATED USE : MAINLY CASH ECONOMY BUT SUBSISTENCE ALSO IMPORTANT				
(This part of the table is included to illustrate the greater potential productivity and efficiency of land use which may become possible - given sufficient knowledge, skill and capital - once responsibility for pastures, crops and livestock are fully integrated under the same authority. It is thought useful to hold up some such idealised objective in training programmes).				
Intensive mixed crop/stock/plantation farming, either separately managed holdings with enclosed pastures, commercially orientated; or large cooperative groups, or state farms. A large proportion of the stock feed can be provided from cultivated pastures and forage crops. Permanent grassland/bushland also contributing substantially especially in non-cultivable localities. Intensive dairying and/or beef production including the possibility of beef feed lots.	Transitional between farmland and rangeland . Large scale cultivation; dairy & beef ranching on enclosed or otherwise legally defined land holdings. Beef production in feed lots a possibility. Permanent pastures supplying most of the forage requirements but cultivated pastures and forage crops also having considerable potential. Cooperative group basis or State-run holdings. Private enterprise in some countries.		High potential commercial ranching country. High quality beef, wool, mutton and goat meat. Some crop cultivation and supplementary forage production in favourable situations. Good potential for cross-breeding. Clearly defined land units. Natural grass/bush/tree communities providing almost all stock feed requirements.	Low potential ranching country having low grazing capacity with delicate plant/animal relationship. Generally beef cattle or sheep but sometimes goats and other stock raised commerically. Game ranching a possibility. Little rainfed crop cultivation except in very favourable situation. Forage crop production depending almost entirely on irrigation.

If and when the stocking rate barrier to ecologically coordinated use can be crossed and the management authority made fully effective and enlightened through sound training and extension, then there opens up a potential for more profitable development, with the possibility of conservation and improvement of resources. Although the difficulties of achieving ecologically co-ordinated use by groups of traditional pastoralists are no doubt very great, movement towards greater ecological stability through programmes of this kind is of the utmost urgency and importance. The alternative is probably accelerated retrogression as populations continue to grow.

The major objectives of training in grassland production are therefore seen to be two-fold:

- to encourage a shift away from traditional uncontrolled communal use towards suitable forms of controlled co-ordinated management, as seen in current endeavours to establish ecologically stable group ranches, co-operatives, and other forms of organisation in some arid and semi-arid regions.
- to teach the proper use and management of ecologically co-ordinated ranching units of all kinds, leading to the full development of animal production potential up to the maximum capacity of any given environment.

It follows that national policies which are aimed at achieving the first of these objectives through various improved forms of organization should become a major subject of training curricula. A separate syllabus to ensure adequate coverage of this important aspect is therefore recommended, and a specimen syllabus has been included later in this report, with the title "Pastoral development planning and administration".

In addition to the major effects of land use system and rainfall, variations in soil type, altitude and other ecological factors can also strongly influence the type and composition of plant communities and may also at least partially influence management.

Each section of the foregoing Table 2 could therefore be further subdivided to include mention of soil effects - especially drainage - and temperature, thus further highlighting the complexity of the subject when studied in depth. Variation also arises from other causes, as for example when the effectiveness of rainfall which is probably the most important single factor, is altered locally by people and animals, through the destruction of ground cover and reduced water penetration.

Because of this complex mosaic of interacting factors, it is recommended that instruction in degree, diploma or certificate courses should be broadly based to start with. It should be aimed at a wide general grounding in the subject, with concentration during the later stages on those parts of the spectrum that are most relevant to particular requirements. Restricting the teaching to too narrow a field at the outset appears undesirable in that potentially useful information may be ommitted, leaving the students unaware of other possibilities. For example, the use of cultivation and seeding equipment common in more intensive farming areas should also be well understood by workers in semi-arid zones who may wish to establish temporary pastures or forage crops in favourable localities. Conversely, managers in higher rainfall areas can benefit from a knowledge of ranch grazing systems, bush control, and other aspects which also apply to moist environments.

A further reason for a rather broad approach in upper and middle level education is that training institutes, because of their high cost, normally have to take in students from quite widely differing environments. Versatility is an essential attribute where trained personnel may often be required to work at different times in diverse situations.

4. Observations on curriculum titles and content

The word curriculum refers in this report to the whole of a training programme which usually includes several separate 'syllabi', with each syllabus relating to a major subject-division (or course) which is taught within a curriculum, such as grassland production, animal husbandry, extension methods, and others.

The title given to a particular training programme generally indicates its major subject and intention, but this need not preclude a fair balance in the composition of the separate syllabi. For example, curricula which lead to a diploma in animal husbandry or health should include a fair proportion of pasture teaching even though the main emphasis is on the animals; and so long as the course content is well balanced, its title is relatively unimportant. Because plants and animals are linked in a close ecological relationship, they should if possible never be far removed in education that is designed to improve a country's livestock industry. It is therefore hoped that relevant aspects of grassland production will more often in future be included as companion syllabi of approximately equal status with animal health and animal husbandry in training curricula, except where a high degreee of specialization is called for. Some of the curricula seen during the recent mission were particularly deficient in this respect.

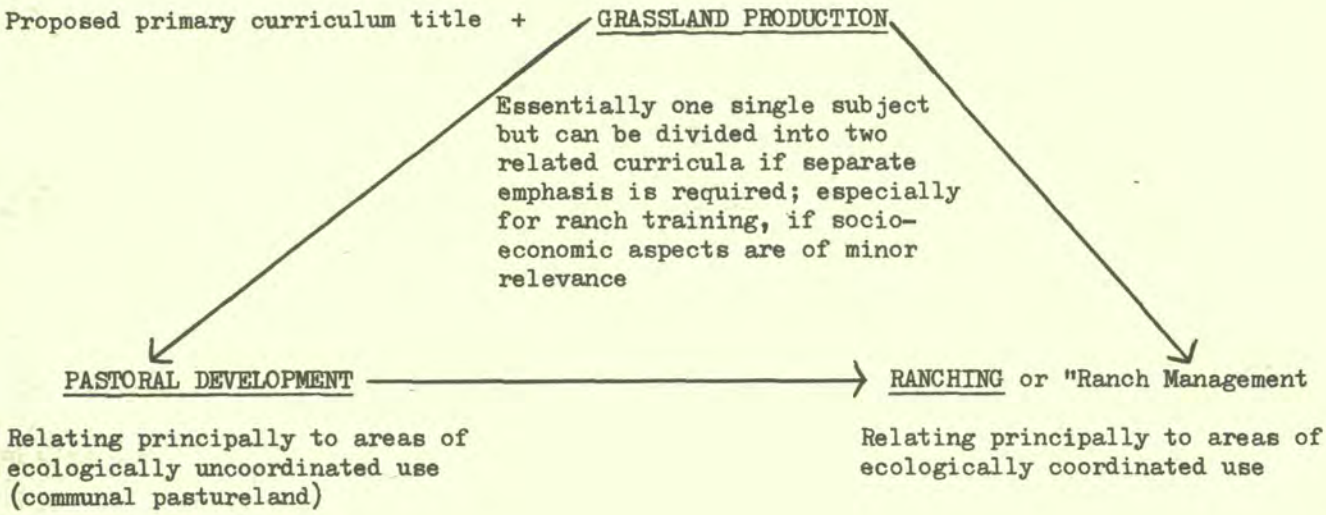
As described, the subject of grassland production is very wide, embracing the vast areas of the traditional communal use as well as the much less extensive areas of ecologically integrated farming and ranching. Although this is a single subject (and its unity is emphasized) it is sometimes convenient to divide it into separate sections if special training emphasis is required on a particular aspect. It is argueable whether, where and how subject matter divisions should be made, but in the author's view the major categories of land use discussed here, represent two rather distinct and separate branches which can if necessary, be taught in separate curricula to suit particular requirements.

In systems of controlled use there is a potential for development of commercially orientated ranching. In systems of uncontrolled communal use, involvement of human society as a dominant ecological factor profoundly alters the situation and calls for a different approach to development, management, administration and education; and training is complicated by this fact. Either branch may, if required, be presented as a separate - though not exclusive - subject (e.g. as in the Tanzania Ranch Management Diploma course, and as taught in American Range Management). Generally, however, this separation is impractical where field staff may be required to work either in communal pastureland or on various developing ranch enterprises, and their training must therefore be comprehensive. In that case, which is the normal one for Africa, all the important subject matter should as far as possible be included within a single curriculum; care being taken to point out to the students, the limitations imposed by human society throughout the whole ecological spectrum and to indicate the relevance of the teaching either to ranching, or pastoral development, or both.

In its original, the term "Range Management" has usually been associated with the management of grazing lands involved in the raising of domestic livestock and wildlife. The former being considered particularly in the context of organized systems of controlled and unified use as defined above with wildlife coming in as a generally uncontrolled but often important user of the ecosystem. Development of traditional range management concepts and practices have not generally addressed many of the specific problems and needs of the nomadic pastoral society engaged in uncoordinated use of the grazing land resources. Thus many training programmes and initial attempts to transfer this technology have been only partially successful or, in instances, complete failures. Furthermore, the term "range" in much of Africa has a more restricted connotation than in North America where it originated, being often interpreted to concern only the arid and semi-arid lands remaining unused for crop production and also external to the meadows and woodlands. Thus this African concept makes the design and implementation of projects in the co-ordinated development and management of the total pastureland production scheme difficult. The highly organized and technological approach to range management, when transplanted to the African scene, often overlooks many of the underlying human problems and frequently fails to treat the underlying causes and needs when seen, for example, from the angle of a Masai or Somali nomad. These needs are, in many respects, very different and should, it is suggested, be recognized in training curricula.

The author knows of no programme available outside Africa which will adequately equip a student to deal with the pressing problems confronting him in areas of uncontrolled communal use. Despite these differences, however, some of the important concepts and practices, especially those of American range management undoubtedly do apply on this continent, especially in ranching, and their usefulness is readily acknowledged.

Therefore, there appears to be a strong case (widely recognized) for forming a fresh and independent pastureland philosophy, better suited to the educational requirements of the developing countries, and using different terms where necessary to avoid confusion. With this in mind, the following curriculum titles and divisions were tentatively suggested, where it is not already too late to change. Given a fresh approach, the syllabus matter required within each curriculum and the details of the pasture component may then, it is hoped, be seen with greater clarity and designed with greater relevance.



The inference of the name grassland production, combining vegetation (grasses, forbs and browse), with animal production, has been referred to earlier in Section 3.

The sub-title Pastoral development, relating specifically to traditional pastoralism includes the idea of plants, animals and people; implying integrated development of the whole biological complex in which human development towards improved quality of life within an ecologically stable environment is of principal concern.

The term ranching, adopted from the Americas, has been used here because of its connotation with controlled commercial entreprise. The chief reasons why it is thought useful, in appropriate circumstances, to treat ranching as a separate branch of grassland production are :

- it facilitates more precise subject matter arrangement and allows for greater in-depth study of commercially orientated pastureland use and development, without the distraction of major social considerations;
- separate ranch management courses are already currently being given in some countries, e.g. Tanzania

It is stressed however, that even though sometimes taught separately for convenience, ranching is in fact a part of the entire subject of pastureland production which will normally be taught in an integrated way.

Some or all of the following subject syllabi (depending on circumstances) appear to be appropriate for the primary grassland production curriculum, at university, diploma or certificate levels as well as for the secondary curricula. Pastoral development and ranching, if they are required to be taught separately in ad hoc courses should be aimed at fulfilling a particular need. Opinions will no doubt differ on the titles and proposed syllabus divisions - and there is room for discussion and variation. It is suggested however, that proper weight should be given to this subject, whatever the form or combination in which it is taught, if a comprehensive course is required.

Primary curriculum : GRASSLAND PRODUCTION

Combines both Pastoral Development and Ranching in a single programme comprised of the following syllabi. Detailed suggestions of possible subject matter which could be included in some of these syllabi are made in Annex 2.

Ecology
Grassland production : which is the major subject
Animal husbandry and animal health
Wildlife
Pastoral development planning and administration
Social organization
Rural economy
Teaching and extension methods
Constructional development
Ranch business management
Grassland research (mainly only for degree courses or for special training).

Secondary curriculum : RANCHING

Comprised of the following syllabi, each to be ranch-orientated and developed separately where ranch management is the particular objective.

Ecology
Grassland production : the major subject
Animal husbandry and animal health (including wildlife where appropriate)
Ranch business management
Ranch constructional development and planning
Grassland research (chiefly for degree or special training courses).

Secondary curriculum : PASTORAL DEVELOPMENT

Some or all of the following major subject syllabi appear appropriate, especially where it is desired to hold ad hoc courses for in-service personnel to increase their capability for handling special problems in communal pastureland.

Ecology
Grassland production : the major subject
Animal husbandry and animal health
Wildlife
Pastoral development planning and administration
Social organization
Rural economy
Teaching and extension methods
Constructional development
Research objectives and procedures (with emphasis on human society) including possible procedures for achieving optimum ecological balance between plant production and animal population, in traditional pastoral areas.

The proportion of time allocated to any syllabus varies according to the required emphasis and depth of training. It is assumed that basic science teaching will in any case be covered as necessary during the introductory phases of middle and advanced level training. There is sometimes a tendency to waste time in the early stages by teaching basic sciences in unnecessary detail (a lecturer's escape mechanism!) - leaving too little time for the important applied subjects. It is therefore suggested that care should be taken to limit the basic science teaching only to the level necessary for efficient field work, especially in the lower academic streams. This remark is not intended to depreciate the importance of essential basic science, but to point out a potential source of weakness.

Syllabi for short courses of adult education at Rural (or Farmers) Training Centres are necessarily much simplified, as are also refresher courses and extension programmes, in which only a few carefully chosen subjects are included.

Practical work is of the utmost importance at all levels, and it is therefore recommended that a large proportion of time - up to 50 percent for subordinate field staff and farmer training - should be spent on practical projects.

5. Length and levels of training

Opinions differ in various countries as to the length and level of training needed. The terms 'Diploma' and 'Certificate', although theoretically indicating higher and lower levels are in fact interchangeable and cannot be relied upon as an index of standard when viewed internationally.

Adequate training at the different levels usually involves about the following lengths of time, including basic science teaching.

TABLE 3 - APPROXIMATE DURATION OF TRAINING PERIODS

Qualification	Grassland Production Comprehensive training including both Pastoral Development and Ranching	Ranching (or Ranch Management) May include a small proportion of Pastoral Development
Degree (Ph.D or M.Sc.)	5-6 years	
Degree - B.Sc.	3-4 years	
Diploma	3 years	2 years
Certificate	2 years	1 year

Ranching should probably never be taught in a separate curriculum at university level. The broader grassland production curriculum, which includes ranching, is more appropriate.

Logically, allowance should be made in reduction of training time when candidates enter more advanced courses if they have recently and successfully completed a course in the same subject at a lower level : as for example, when studying for a diploma after attaining a certificate.

University education is considered essential in this subject for the professional grades of administrators, research workers and teachers - thus, the establishment of B.Sc. degree courses with additional facilities for postgraduate training in Africa appears to be urgently necessary. The sub-professional grades can generally be filled by people of Certificate standard - who can later be given additional in-service training in short courses if necessary for specific purposes or for up-grading through diploma courses on the basis of proven merit in the field.

II. KENYA - CURRENT PROGRAMMES

6. General Information - Kenya

6.1 People contacted

Date	Name	Title	Place
10.1.77	Mr C.H.H. ter Kuile	FAO Country Representative	UNDP, P.O. Box 30470, Nairobi
"	Mr L.J. Ayuko	Head of Range Management Division	Ministry of Agriculture Box 30028, Nairobi
"	Mr F. Abercrombie	Range Officer	USAID, P.O. Box 30261, Nairobi
"	Mr C.N. Mwangi	Senior Agricultural Information Officer	Ministry of Agriculture Box 30028, Nairobi
11.1.77	Mr G.O. Ogola	Staff Training Officer	Ministry of Agriculture, Nairobi
"	Mr W.M. Kahuki	Farmer Training Officer	Ministry of Agric., Nairobi
"	Dr G. Kamau	Principal	Animal Health and Industry Training Institute (AHITI), P.O. Kabete
"	Mr G. Ayiga	Lecturer i/c, Range Management Studies	AHITI, Kabete
12.1.77	Dr G.A. Orie	Deputy Principal	Egerton College of Agriculture, Njoro
"	Mr P. Metto	Lecturer in Range Management	Egerton College
"	Mr S.L. Koros	Provincial Range Officer, Rift Valley	Nakuru
13.1.77	Mr I. Kemei	Head of Range Management Department	Egerton College
"	Dr P.T. Obwaka	Principal	Egerton College
"	Mr J. Nyangwaria	Principal	Farmers Training Centre, P.O. Box 5, Narok
14.1.77	Dr A.B. Carles		Faculty of Veterinary Medicine, Kabete
"	Prof. R.S. Musangi	Dean	Faculty of Agriculture Kabete
31.1.77	Dr N.K. Pham	Senior Programme Officer i/c Arid and Semi-Arid Land Ecosystems	UNEP, Nairobi
"	Dr H. Lamprey	Project Coordinator, Integrated Project on Arid Lands (IPAL)	Nairobi
"	Dr N.J. Nissen	Director, International Livestock Centre for Africa (ILCA)	Nairobi
1.2.77	Prof. P.M. Ahn	Professor of Soil Science	Ministry of Agriculture, Nairobi
"	Mr E.K. Mureithi	Extension Services Officer	Ministry of Agriculture, Nairobi
"	Mr S.M. Mutisya	Principal of Giriftu Farmers Training Centre, Wajir	Nairobi
2.2.77	Dr I. Hag	Senior Programme Officer	UNEP, Nairobi
"	Dr V. Johnson	Senior Programme Officer i/c Environmental Education and Training	UNEP, Nairobi

6.2 National statistics

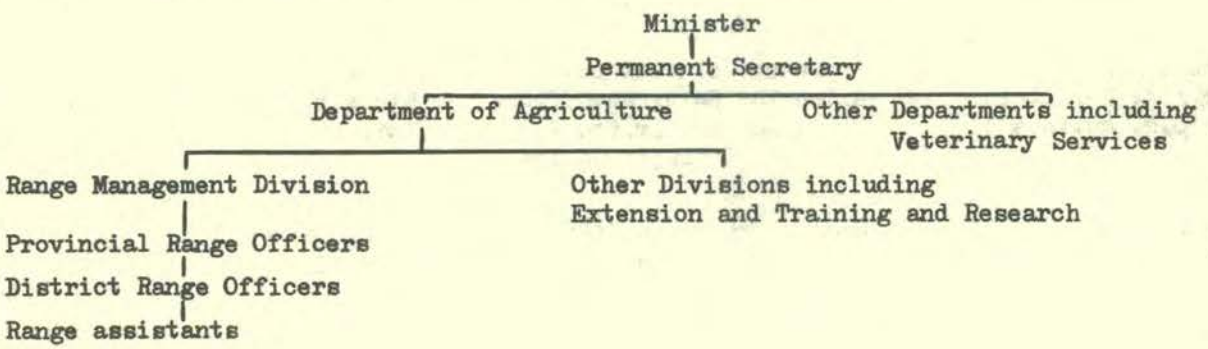
Total land area	569 251	km^2
Approx. total area of pastureland	498 500	km^2
Approx. percentage of arid and semi-arid pastureland	80	%
Approx. national herd totals (1974)		
(FAO statistics) (cattle	7 400 000	
(sheep	3 200 000	
(goats	3 600 000	
Percentage of national herd in predominantly pastoral regions	60	%
Estimated annual rate of herd increase	2	%
Estimated contribution of stock products to GDP	8	%
Contribution of stock products to total exports	6	%
Country total of human population (1974)	12 379 000	
Proportion of population living in predominantly pastoral regions	2 000 000	
Estimated annual rate of population increase	3	%

The data show that roughly four-fifths of the country, which is arid or semi-arid pastureland, is occupied by approximately one-sixth of the population who own at least half of the national herd.

The importance of these areas is well recognized by the Kenya Government, who have made a large financial provision of over K.sh. 450 million, for the development of group ranches, grazing blocks, research and other projects.

6.3 Administrative organization

Responsibility for organization and administration of projects relating to pastoral regions rests with the Range Management Division of the Department of Agriculture, while training at the Certificate level and the Farmers Training Centres is administered by the Extension and Training Divisions. The status of the Range Management Division and deployment of authority is illustrated by the following diagram.



6.4 Estimates of personnel requirements

It was not possible to obtain a forecast of the need for trained staff of different grades for both the private and public sectors, but projected requirements within the Range Management Division, from 1976–1979 were stated as :

Technical Consultants (Certificate)	180
Technical Officer II (Diploma)	90
Range Officer II (Degree)	25

Needs within the Range Officer category, in the near future, will be provided largely from staff trained in the USA through scholarships awarded by USAID. It is expected that a few requirements may also be met by graduates holding the B.Sc. Degree in Agriculture from Nairobi University. This figure of 25 R.O. II may not take full account of the recent proposals for increased range research in Kenya (8) if they are to be adopted. It was suggested in that report that about 30 graduates will be required for research alone, with a support staff of three times that number. Also USAID, which will continue for 8–10 years as from 1974, is reported to have estimated that the National Range and Ranch Development Project may need a total of up to 70 officers by the early 1980s. The grand total is 395 with some level of professional or technical training.

Although, in the final analysis work openings are dictated by finance, the demand for trained men appears likely to increase rather than to diminish, as the large capital inputs take effect.

The apparent lack of precise staff forecasts in all sectors for pasture and related work is obviously a handicap in relation to training. The preparation of such estimates should, it is thought, be given priority. Initial estimates could perhaps be prepared with assistance from one of the external agencies.

Broadly speaking however, it appears that facilities for middle level – diploma and certificate training – are about adequate to supply staff needs provided that present outputs are maintained. The major lack is in graduate training.

7. University courses

The need for university training in range management is recognized, and a selection committee was appointed in February 1975 to consider this and to make recommendations to the Faculty Board. No final decision had been reached at the time of the visit but was expected early in 1977.

At present the University offers a general course leading to the degree of B.Sc. Agriculture, with no options.

Three alternative ways of meeting the need for graduate range staff have been discussed. These include , inter alia,

(a) Undergraduate

(i) introduction of range management components in the existing courses of the present B.Sc. Agriculture degree;

(ii) a new B.Sc. course for range management.

(b) Postgraduate

(i) One year diploma;

(ii) M.Sc. in range management involving about one year's teaching and one year's work on a selected project.

(c) Overseas training in lieu of part or all of the above.

The average cost of sending a student for training in USA was quoted (1975) as :

	$
One year	11 100
Two years	20 700
Three years	30 300

Relative costs depend on numbers involved. With very small numbers overseas training is cheaper, but with larger numbers, local training will cost less.

Opinions are still divided on whether it will be sufficient simply to offer M.Sc. postgraduate training in range management. The consensus at the time of the visit was apparently in favour of a B.Sc. Range Management degree, which has also been supported by Professor T.W. Box of Utah State University in recent discussions.

Reasons given in favour of mounting a separate B.Sc. course in range management rather than offering this subject at M.Sc. level only, include:

(a) the importance of providing an adequate academic foundation early;
(b) the difficulty of attracting graduates to undergo postgraduate training in this relatively unfamiliar subject when they can find attractive openings elsewhere.

In more general terms, there are strong reasons for mounting a B.Sc. course in range management at Nairobi university (with which the writer concurs). These are :

(a) a great need for 'Africa-based' and 'Africa-orientated' training at the highest levels, so that future leaders may be better equipped to deal with the problems confronting them;

(b) establishment of such a training centre is likely to attract foreign financial support, as well as quite large numbers of students from other African countries where such training is urgently needed and at present unavailable;

(c) Kenya (together with some other states) is ideally suited for such courses because of its widely varying country in which the complete range of development from subsistence pastoralism to sophisticated modern ranching and feedlot enterprise, is represented; as well as the whole spectrum of land use from intensive enclosed mixed farms , with use of planted pastures and forage crops, through to extensive stock raising in the drier zones.

The existing university facilities which could be expanded if called for, by additional finance, staff and buildings, are said to be sufficient for an intake of about 10–15 postgraduates students at a time if the M.Sc. option is adopted. These could comprise roughly about two–thirds Kenyans and one–third foreign students.

It has been suggested, logically, that some of the candidates for B.Sc. courses should be drawn from the best available Egerton College Range Management diplomates after a spell of say about two years' field work.

An estimate (in 1975) of Range Management graduate requirements was put very provisionally as about 64 needed in all sectors by 1980, as compared to the estimate of 25 indicated above. Whatever the exact figure, the starting of these courses appears to be a matter of urgency.

Although, at the time of writing, no decision has been reached concerning the form in which range management training should be given, the following curriculum summary is reproduced here to illustrate the lines along which discussions have been proceeding.

Curriculum and course outlines for a Degree in Bachelor of Science in Range Management prepared by the University staff and tentatively proposed for discussion

In summary, the proposed B.Sc. Range Management Course would overlap considerably with the B.Sc. Agriculture course (as given in 1976–77) but incorporates six new courses totalling 570 hours. These new courses take the place of B.Sc. agriculture courses in such a way that the total number of hours for the proposed B.Sc. in Range Management is 40 hours shorter than that of the existing B.Sc. Agriculture, which some consider to be overloaded.

The proposed six new courses, marked *, are outlined at the end of the following summary.

First Year

1. Introduction to East Africa Agriculture (including a tour lasting two weeks of important agricultural regions in Kenya) – 50 hours plus field trips

   Note: It would be advisable to have this as a special trip to dryland farming and ranching regions of Kenya, or at least to ensure that the general trip includes visits to ranches and stations such as Kiboko.

2. Mathematics – 50 hours
3. Chemistry – 110 hours
4. Zoology for Agriculture – 130 hours

   Note: It would be preferable if some time could be given to wildlife as well as to domestic animals.

5. Physics for Agriculture – 50 hours
6. Biochemistry – 90 hours
7. Statistics – 64 hours
8. Botany for Agriculture – 130 hours

*9. Nature of Rangeland and Introduction to Range Ecology - 90 hours

(This is a new course taking the place of Genetics and Plant Breeding) see course outlines below.

10. Plant and Crop Physiology - 65 hours
11. Animal Physiology - 65 hours
12. Economics I - 45 hours

Second Year

13. Economics II - 40 hours
*14. Rural Sociology and Development of Dominantly Pastoral Area - 40 hours

(This is a new course (see outlines below).)

15. Farm Management - 70 hours

Note: Examples from ranching would have to be included

*16. The Botany of Rangelands - 140 hours

(A new course substituting for Crop Production I (see course outlines below)).

17. Animal Production I - 170 hours
18. Agricultural Engineering I - 140 hours

Note: Some modifications may have to be made to include aspects of water-spreading, etc.

19. Soil Science I - 110 hours
20. Agricultural Policy - 40 hours

Note: Reference to pastoral areas and rangeland will need to be included

21. Agricultural Law - 24 hours
22. Ranch Practice (6 to 9 weeks' practice on selected ranches during the 4th term)

Third Year

*23. Economics of Livestock Production on Rangelands - 40 hours

(This is a new course in place of Farm Management II (see course outlines below)).

*24. Range Management - 110 hours

(This is a new course in place of Crop Production II (see course outlines below)).

25. Animal Production II - 50 hours
26. Agricultural Engineering II - 80 hours

Note: The same remark applies here as for Agricultural Engineering I (Course 18 above)

27. Soil Science II - 110 hours

*28. Rangeland Ecology - 150 hours

This is a new course in place of Crop Protection (see course outlines below).

29. Animal Health and Hygiene - 50 hours
30. Agricultural Marketing - 40 hours

Note: Aspects of ranching enterprise should be included

31. Agricultural Extension - 40 hours

Note: Ranching should be covered.

Course outlines

The outlines of the proposed new courses are :

9. The nature of Rangeland and Introduction to Range Ecology (90 hours)

Ranching versus farming. Geography of rangeland in East Africa. Environmental vegetation classifications. Land-use potential. General economics and sociology of rangeland and ranching.

14. Rural scoiology and development of dominantly pastoral areas (40 hours)

Social systems and their influence on behaviour : traditional African societies. Human behaviour in society, labour migration and structural conflicts. Impacts on production factors and on change in dominantly pastoral areas. Production under conditions of factor scarcity. Changes in farming systems in pastoral areas. Innovations and capital accumulation. Nutritional aspects. Growth incentives, strategies and conditions for development and employment generation.

16. The botany of Rangelands (140 hours)

Taxonomy and floristics of the major grasses and legumes together with other range forage plants. Grassland, trees and shrubs. Sight identification and keying out of unknown plants. Herbarium procedures. Ecological relationship of the vegetation with animals, i.e. nutritive values, grazing hardiness, life histories, reproduction and seeding potential, species autecology.

23. Economics of Livestock Production on Rangelands (40 hours)

Socio-economic characteristics and classification of various livestock enterprises in farming and ranching. Factor prices, factor proportions and livestock productivity. Trends in livestock prices. Intensive stages of ranching: nomadic grazing, stationary grazing with and without fencing, supplementary feeding. Economics of forage utilization by animal classes and nutrient requirements. Benefit/cost ratios of various management schemes. Optimum management plans. Application of optimization and simulation techniques. Case studies.

24. Range Management (110 hours)

The application of ecological principles to the management of East African rangeland. Grazing systems, range improvement, control of stocking rates and stocking units. Multiple use of rangeland, range conservation including wildlife management, herd control, migration, drought action, rehabilitation, pest control. Supplementary cropping, i.e. dry farm production.

28. Rangeland ecology (150 hours)

Basic ecological concepts, vegetation studies, mapping and surveys. The rangeland environment, habitat factors, dynamics, floristic analysis, range inventories, trend and condition, animal vegetation studies, population ecology, rangeland as an ecosystem.

As a general comment it appears that considerably more than 40 hours will be needed adequately to cover Course 14, Rural Sociology and Development of Dominantly Pastoral Areas, and this should perhaps be continued during the third year. The all-important subject - Human Population dynamics and its direct and indirect impact on pastoral resources requires emphasis. It is suggested that some time should also be devoted to a review of past failures and successes in grazing land development policies.

8. Diploma courses

The Egerton College of Agriculture offers diploma courses, each of three years' duration, in the following subjects :

Agriculture and Home economics
Animal Husbandry
Agriculture
Horticulture
Dairy Technology
Farm management
Agricultural education
Agricultural engineering
Range management

The College is administered by a Board of Governors on which the Ministry of Agriculture is represented.

The annual intake for range management is up to 30 students, of which roughly two-thirds may be Kenyan and one-third from other countries, mainly Tanzania and Uganda. Interest from outside Kenya is said to be increasing. The College accepts about 40 certificate holders from various other Kenya institutes, for upgrading, annually. Of these about three or four have certificates from the two-year Range Management course given at the Animal Health and Industry Training Institute (AHITI), Kabete. Regrettably, no allowance is made for the certificate training - which covers much of the same ground - and the entrants have to undergo the full three year course including basic teaching already covered previously. This has been a matter of discussion for several years, and it is difficult to see how the authorities can justify such a waste of time and money.

The most that should be necessary for 'topping-up' from certificate to diploma level is about an 18 month period, and a year's concentrated theory and practical instruction could well suffice. The difficulty of mounting separate upgrading courses each year for small numbers of certificate holders is appreciated, but this could perhaps be overcome by holding a special shortened course for a group of say 12-15 AHITI trained range management candidates once in about every 3 - 4 years.

The range management diploma includes instruction given by the following Departments:

Basic Science Departments	(Biology (Chemistry
	(Range Management (Crop Production (Economics
Applied Science Departments	(Animal Science (Engineering (Education and Extension (Home Economics

The following summary of subject time allocation, and the present course outline is as follows.

Diploma in Range Management : course/time/subject summary

Course	Hours (Theory/prac.)		Short title
First year			
Term I	10 weeks		
Homec	20 hours		P.B.F.L. (Planning for Better Family Living)
Bio	60 "		Agricultural Botany
Bio	60 "		Veterbrate Anatomy and Physiology
Chem	40 "		Physical Chemistry
Econ	20 "		Price Theory and Market Formation
Educ	30 "		Introduction to Language Communication
Engin	30 "		Introductory statistics
	260 hours	=	26 hours per week
Term II	10 weeks		
Bio	40 hours		Plant Taxonomy
Bio	40 "		Entomology
Bio	40 "		Parasitology
Chem	60 "		Soil Physics
Engin	30 "		Elementary Sketching
Range	20 "		Introduction to Range Management
	230 hours	=	23 hours per week

Course	Hours (Theory/prac.)		Short title
Term III	10 weeks		
Homec	20 hours		Human Nutrition
Ansci	20 "		General Practicals
Ansci	20 "		Livestock Breeds
Bio	20 "		Ecology
Bio	30 "		Genetics
Chem	70 "		Organic and Nutrition Chemistry
Econ	30 "		Production Economics
Engin	40 "		Fabrication
Range	70 "		Principles of Range Management
	320 hours	=	32 hours per week
Second Year			
Term I	10 weeks		
Ansci	20 hours		General Practicals
Ansci	30 "		Animal Nutrition
Ansci	20 "		Animal Health
Chem	60 "		Soil and Fertilizer Chemistry
Crops	30 "		Principles of Crop Production
Dairy	10 "		Dairy Industry in Kenya
Engin	30 "		Tractor Servicing and Operation
Range	40 "		Range Plants
	240 hours	=	24 hours per week
Term II	10 weeks		
Ansci	20 hours		General Practicals
Ansci	30 "		Animal Breeding
Crops	30 "		Pastures and Fodder Crops
Econ	30 "		Farm Records and Accounts
Engin	50 "		Surveying I
Range	110 "		Range Inventories
	270 hours	=	27 hours per week
Term III	10 weeks		
Ansci	20 hours		General Practicals
Ansci	30 "		Animal Reproduction
Ansci	50 "		Ruminant Diseases
Econ	40 "		Farm Management
Educ	20 "		Technical Report Writing
Educ	30 "		Introduction to Rural Sociology
Engin	50 "		Soil and Water Conservation
Range	20 "		Wildlife and Range Use
	260 hours	=	26 hours per week

Third Year

Term I	10 weeks		
Ansci	40 hours		Beef Production
Ansci	40 "		Sheep Production
Ansci	30 "		Ruminant Diseases
Econ	20 "		Marketing Policies
Econ	30 "		Livestock Development Economics
Educ	20 "		Principle of Extension Education
Engin	50 "		Water Supply for Range Management
Range	110 "		Range Improvements
	340 hours	=	34 hours per week

Term II	10 weeks		
Ansci	20 hours		Livestock duties
Ansci	20 "		Beekeeping
Ansci	30 "		Goat Production
Econ	30 "		Economic Development
Educ	30 "		Extension Programmes
Engin	40 "		Farm Structures
Range	80 "		Grazing systems and management planning
Range	130 "		Range Observation (vacation period)
	250 hours	=	25 hours per week

Term III	5 weeks		
Ansci	20 hours		Seminars
Ansci	10 "		Plant Poisoning
Ansci	10 "		Hides and Skins
Educ	20 "		Government Procedure
Range	40 "		Seminars
	100 hours	=	20 hours per week

Range Management Department : course outlines

Seminar

Lecture given by invited specialists on specific Range related topics; discussions on assigned written topics; readings in Range Management literature and related fields.
Seminar - 20 hours.

Introduction to Range Management

Range Management as an art and science; its nature and scope; History and relationship to other disciplines; Significance of the course taught in range curriculum, to semi-arid problems; the climatic, edaphic, biotic, physiographic and special characteristics of East African rangeland; Range resources; multiple land use in East Africa.
Lecture - 20 hours.

Principles of Range Management

Range Management as applied ecology; Range vegetational types of East Africa; Ecological zones; Range sites; Range use in relation to climate, physiography, soils and biotic influences; Grazing in relation to plant physidogy and ecology; Range indicators of condition, Processes and uses; Multiple range use and Proper use.
Lecture/Practical - 30/40 hours.

Range Plants

Introduction - Autecology and synecology; characteristics of Range Environment and the Range Plant; Seed casting and Planting; Factors affecting viability, Germination, Emergence, and Establishment, Factors affecting Growth and Reproduction; Ecological amplitude; life forms of Range vegetation; Autecology of the important East African range grasses.
Lecture/Practical - 20/20 hours

Wildlife and Range Use

Values and problems of Game in East Africa rangeland; the study of wildlife biology; Wildlife of East African rangelands with special emphasis on big game; Habitat factors; Population Characteristics and dynamics; Utilization and Management; Wildlife laws; the responsibilities of a Game Warden.
Lecture - 20 hours

Range Improvements

Range rehabilitation and Range improvements; Bushland and bush control; assessment of the problems; ecology of bushlands in East Africa; Bush control methods; Artificial revegetation; Water spreading; Pitting; Contour furrowing; Livestock water developments; Range fences and bomas.
Lecture/Practical - 30/80 hours

Range Inventories

Random Sampling techniques; Methods of estimating production of range forages; Methods of determining production before and after utilization; Methods for determining botanical composition and cover; Methods for determining utilization; Methods for determining Range condition and trend; and Aerial photo interpretation.
Lecture/Practical - 30/80 hours

Range Planning and Grazing Management

Principles of planning; Formulation of relevant planning questionnaire; Use of the questionnaire to elicit Range/Ranch information; Information organization and analysis; Development of a Ranch Plan-needed developments, Livestock projections, Costs and benefits; Livestock management plan; considerations in a grazing system; design and selection of a grazing system; Methods of grazing systems; Planning and establishment of grazing systems.
Lecture/Practical - 30/50 hours

Range observations

Practical studies on Wildlife at Tsavo National Park; observations of Range vegetation types; visits to various types of ranches; Discussions of problems facing range technicians in the field.
Practical/Tours - 130 hours

The total time allocated to the Range Management Department is therefore :

	Hours
Lectures and seminars	200
Practical work	270
Tours to wildlife and ranches, and discussions	130
	600

In addition, 30 lectures are given by the Crop Science Department in pastures and fodder crops.

Students in both Agriculture and Animal Husbandry courses also receive 30 lectures on pastures and fodder crops, and 20 on introduction to range management, which appear very inadequate, especially for Animal Husbandry.

The probable starting of range management degree training at Nairobi University raises the question of how this will affect the Egerton diploma since there may then be little difference between the two if a B.Sc. course is decided upon. It appears, therefore, that while the present Egerton out-turn should be maintained, the course content will require re-appraisal with a view to shifting towards a more practical approach with extra time spent in field training on ranches and in pastoral areas.

Such a re-appraisal will logically affect the AHITI certificate course if the present three-tier structure is to be maintained, since the difference between it and the diploma

will be narrowed still further. At present this difference is probably slight in terms of post-training work preparedness even allowing for different job descriptions.

It is therefore thought that, soon after agreement has been reached on the university programme, a meeting convened by the Ministry will become necessary to agree on policy and curriculum details for each institute. This will be essential in order to stratify the programmes and minimize needless overlap; special attention being given to the practical content.

Suggestions concerning future policy are made in Section 9.2.

9. Certificate courses

9.1 Curriculum details

Two-year courses are offered at AHITI, Kabete, for candidates of School Certificate or near School Certificate standard. The intake is up to 60 range management trainees annually, divided into two classes of 30 each. As many as about half have in the past come from other countries including Tanzania; Sudan; Ethiopia; Swaziland; and Botswana.

The present official staff complement is three lecturers and two demonstrators. The aim is to turn out ranch managers or assistants, extension and training instructors, research assistants and technical assistants for the large pastoral development projects. These men fill an important role in development at the 'grass roots' level, forming an essential link between the higher administration and the people. They can exert great influence on progress, and may in some ways be regarded as the 'backbone' of the development drive.

The training programme summarized below embraces both pastoral development and ranching in a single curriculum.

The two years are made up of three terms of 13 weeks each annually: i.e., a total of 6 terms, based on six student contact hours daily for five days a week, totalling 390 hours per term, which includes field trips, discussion seminars and examinations headed below as 'Miscellaneous'.

Curriculum subject time summary

1st year	Total hours (Theory/Prac.)
Term 1	
Ecology/Botany	120
Anatomy and physiology, and micro-biology	90
Animal production	10
Chemistry and physics	70
Government organization and procedures	10
Miscellaneous	90
Term 2	
Range pastures	176
Micro-biology	22
Immunology and vaccines	17
Parasitology and pathology	60
Animal Production	22
Farm business management	11
Agriculture and farm machinery	22
Miscellaneous	60

	Total hours (Theory/Pract.)

Term 3

Times used for external training as follows :

Naivasha Dairy Training School	1 week
Kiboko Range Research Station	4 weeks
Ngong Farm	8 weeks

While at Ngong the students undertake supervised practical work relevant to range management; animal husbandry; animal health; extension; and farm machinery and construction.

2nd Year

Term 4

Range Management	110
Animal health	77
Animal Production	66
Farm business management	33
Extension	44
Miscellaneous	60

Term 5

Range Management	121
Animal health	66
Animal production	66
Farm business management	33
Extension	44
Miscellaneous	60

Term 6

Range management	100
Animal health	60
Animal production	60
Extension	40
Farm business management	30
Government procedure	10
Miscellaneous	90

Summary of range management course outline

Term 1

Introduction to biology
Plant morphology
Plant physiology
General ecology

(a) Introduction
(b) Ecological communities
(c) Ecosystems
(d) Practical application to pastoral development and ranching

Plant ecology

(a) Definition and scope
(b) Environmental influences on plants
(c) Development of plant communities
(d) Structure of plant communities

Plant taxonomy
Pasture plants

Term 2

Categories of pastures (including annual forage crops) and their uses
The role of Legume/Rhizobium symbiosis in pastureland
Seeds of pasture plants
Establishment of planted pastures (including forage crops)
Pastureland productivity and stocking rates
Nutritive value of pastures
Forage conservation
Pests of pastureland
Introduction to pastureland management
Ecology of rangeland

(a) Introduction to range ecology
(b) Climate (including water distribution)
(c) Soils
(d) Biotic factors
    (i) Plant/animal interactions
    (ii) Human influences
(e) Fire
(f) Ecological and physiognomic classifications
(g) Physiographic factors

Socio-economic and political status of Kenya rangelands

Term 3

Field practical work includes :

Points to note when visiting a ranch
Fencing
Design and construction of crushes and bomas
Land measurement
Vegetation survey techniques
Map reading
Ranch buildings
Water reticulation

Term 4 (second year)

Range ecology revision
Pastoral peoples and their environment
- (a) The current social scene
- (b) Current animal husbandry practices: attitudes to livestock.

The scope and importance of range management

- (a) History of range management in Kenya
- (b) Objectives

National pastoral development policies

- (a) Pre-development survey
- (b) Current development programmes
- (c) Problems and possible solutions
  - (i) Education
  - (ii) Finance
  - (iii) Water
  - (iv) Lack of information
  - (v) Development progress

Desirable changes in livestock husbandry practices amongst pastoral peoples :

Wildlife
- (a) A national resources
- (b) Problems of wildlife conservation
- (c) Wildlife utilization
- (d) Wildlife research

Ranch planning priorities

- (a) Water supply
  - (i) Importance of water
  - (ii) Principal sources of water

Term 5
  - (iii) Surface water supply
  - (iv) Ground water supply
- (b) Livestock
- (c) Buildings
- (d) Roads and stock routes
- (e) Stock handling facilities
- (f) Transport and equipment
- (g) Economic aspects of development

Management practices

- (a) Conservation of resources
- (b) Proper use of pastureland
- (c) Stocking rate: plant/animal balance
- (d) Pastureland management
  - (i) Grazing systems
  - (ii) Special problems of communal grazing in arid areas: nomadism
  - (iii) Use of fire
  - (iv) Drought action

Ranch improvement

(a) Ranch inventory; condition and condition trend assessment

Pasture improvement

(a) Bush control
(b) Rehabilitation of denuded pasturelands
(c) Irrigation procedures
(d) Water spreading
(e) Other water conservation practices

Water supply improvement

(a) Water equipment
(b) Storage tanks and drinking troughs

Livestock improvement
Other improvements

(a) Ranch buildings
(b) Ranch roads and stock routes
(c) Stock handling facilities
(d) Boundary enclosure and internal subdivision

The future of the certificate courses, as with the diploma stream, should probably be towards a greater proportion of practical training under field conditions - with up to 50 percent of the time spent away from Kabete which is not suitably placed for ranch training, but serves as an excellent base.

Ideally, students on field training should be divided into rather small groups of not more than 10-15, but this poses a logistics problem. To accomplish such optimum groupings it will be necessary to increase the number of Instructors (Demonstrators) from two to at least four to give adequate supervision. While on field work it is important to arrange instructional exercises such as vegetation survey, range condition assessment, and census work. Although such courses must necessarily include some manual work (and this should be accepted as normal) students resent being used as a source of cheap labour. This feeling should be avoided by designing meaningful and instructive field projects.

Availability of sufficient transport and camping equipment is another essential where courses involve a large proportion of field training; and success depends largely on vehicle maintenance, drivers, catering and other logistical details.

Minimum transport requirements for the servicing and supervision of 60 students on long periods of field training is estimated as :

in sound working condition
(2 buses
(1 5-ton lorry
(2 Land rovers

It appears that further financial provision will be necessary for providing vehicles.

9.2 Suggested future policy: diploma/certificate courses

At present there is little difference in the level of school education (except for some candidates in the semi-arid pastoral regions) between many entrants for the certificate and diploma courses; often only a few examination marks dividing the AHITI and Egerton streams, which disproportionately affect a man's status and income thereafter. The difference in educational standard and the differences in course curriculum content - in which AHITI appears superior to Egerton in some respects - are not, in the writer's opinion, sufficient to justify the large extra expense of maintaining the Egerton Diploma course in its present form, if B.Sc. degrees are to be offered in Range management at Nairobi University.

It is therefore suggested that school leavers of the required standard should in future all enter the AHITI certificate course in range amangement and that the best of these should after a period of say two years' field work, go on to Egerton for one year's upgrading leading to the Diploma in Range Management. Thus the direct intake of school leavers to Egerton for the three year diploma would be discontinued in favour of the one-year upgrading courses, and the annual intake would then be more seasoned men having had valuable practical experience.

Diploma candidates could then be selected according to a formula incorporating :

- formal school education achievement
- standard achieved in the AHITI certificate course
- proven working ability and character under field conditions

Such an arrangement would have the advantages of :

- reducing training costs;
- reducing loss of working time;
- increasing the likelihood of the best men entering the more senior posts;
- removing a major cause of frustration amongst certificate students who feel (understandably) that the large difference in salary and status between AHITI and Egerton 'graduates' is inequitable;
- removing the present anomaly whereby ex-AHITI students who go to Egerton have to undergo a further full three-year course;
- encouraging a more dedicated and contented service by opening up a wider avenue of promotion for the best certificate-holders

10. Farmers' Training Centres

FTCs are administered by the Ministry of Agriculture, Extension and Training Divison. The two most directly concerned with short courses for pastoralists - mainly adult men and women - are situated at Narok in Rift Valley Region and at Giriftu, near Wajir in the N.E. Region. A third FTC, the Masai Rural Training Institute near Kajiado, which is Church administered, also provides courses in range management with support from the government teaching staff.

A number of other Centres, including Ngong FTC near Nairobi, give some pastureland teaching, but often more related to agricultural zones than to rangeland.

A summary of facilities and activities at the three ' pastoral' FTCs follows :

Narok

Present capacity : 30 people, with plans for increasing to 60.
Area of ranch, 385 ha.
Average duration of courses; 1 week
Fees charged per person/week: sh 15/-
Courses are held twice monthly
Subjects include:

Ranch management - given mainly to farmers and personnel (including some women) from the Narok district group ranches

Home economics - for women

Crop production - for farmers from the higher rainfall areas

4-K clubs - youth training for primary school students below about 15 years old.

Cooperative movements

Farm management - emphasizing farm planning and soil conservation. Work is mostly done outside; with minimum time spent in the classroom. Teachers are drawn mainly from Government specialist staff working in the district. FTC affairs are guided by a committee comprised of local government officials.

Giriftu FTC

Present capacity: 23 people
Area of ranch: 50 000 ha. (this is very dry country)
Average duration of courses: 1 week, with two held each month
Fees charged: sh 15/- per person/week
The raising of this money is a problem for some, as it usually entails the sale of a goat!

Trainees come mostly from the large 'Grazing blocks ' at present being developed by the Government in that region with USAID assistance.

Recruitment for the courses presents a logistics problem because of the distance involved. Course subjects are principally concerned with ranching and stock husbandry but the facilities are available for meetings, seminars and other subjects when called. FTC affairs are guided by a management committee comprised mainly of Government officials.

Masai Rural Training Centre: 'Isinya'

Capacity of the Training School: 30 people
Area of ranch 80 ha.
Average duration of short courses in range management: 2 weeks
Fees charged: sh 15/- per head per course
Number of courses: 4-8 annually

Recruitment is from the Masai pastoralists and to date well over 1,000 have attended.

The intention is gradually to phase out the short courses in this subject and to concentrate more on longer-term training to provide workers for the individually-owned group ranches in this district. Courses start in June and consist of 39 weeks, divided into three terms of 13 weeks each, with a three-week break between terms. The emphasis is almost entirely on practical training in range management; animal health, farm management; and animal production. A certificate (not officially recognized by Government) is awarded on completion of training.

This represents an evolutionary step from the normal FTC short courses, which could perhaps be considered later at other centres where there is a demand for trained 'headmen' or 'foremen' to fill a need on developing ranches.

Useful advice about teaching procedures, syllabus content, and equipment of FTCs was given in an earlier FAO report. (6). This should be read in conjunction with these remarks for a fuller picture of training potential at FTCs. The following quote is most relevant :

"Assuming that the participants may well be illiterate, and thus easily bored, it is as well to avoid the long formal lecture and concentrate on practical work/demonstrations. For this reason it is necessary to allocate fairly long periods which will allow time for visits to various parts of the ranch, and to ensure that each participant has the time to practice any routine operation being demonstrated".

The following are summaries of some of the subject matter currently being taught in the courses at both Narok and Giriftu.

Narok: Example of Timetable arranged for 'Group Ranch' development

Sunday	Collection of students from a given area (by FTC transport)
Monday	Introduction and Registration - principal
Morning	Opening of the course by the Chairman, Narok County Council, Social problems affecting group ranch development
	Ranch economics, planning, recording and utilization
Afternoon	Bush control
Tuesday	Livestock Disease control
Morning	Group ranch management and administration Water development
Afternoon	free
Wednesday	Livestock improvement
Morning	Dipping and dip management practicals Agricultural cooperatives Beef cattle breeds and breeding
Afternoon	Discussion Films

Thursday	Tour
Friday	Purpose of Agricultural Finance Corporation (AFC) loans
Morning	Crop production wheat development Land use and soil conservation, care of farm equipment
Afternoon	Free Films
Saturday	Course evaluation - discussion
Morning	Closing of course - the District Commissioner Students depart

Giriftu: Programmes are made up from amongst the following subjects

Introduction. Discussion of pastureland characteristics: rainfall, vegetation and soils.

Important renewable and non-renewable resources.

Conservation of resources

(a) Vegetation
(b) Water. Catchment protection.

Range use.

(a) Proper use.
(b) Proper kind of animals.
(c) Correct stocking rate.
(d) Correct distribution of animals.

Range development.

(a) Water development and maintenance; pans and boreholes.
(b) Roads and fire-breaks.
(c) Stock handling facilities.
(d) Maintenance.

Animal husbandry.

(a) Introduction.
(b) Management practices.
(c) Marketing.
    (i) Live animals.
    (ii) Stock products.

The FTCs form one of several important links between the Government and the people, for the communication of new ideas. It is hoped eventually that each district may be served by one of these institutions, but the cost is high, and in the meantime priority is being given to maintaining and building up the existing centres.

The semi-arid pastoral areas are more difficult to serve than are the agricultural zones because of the large distances involved; lack of suitable conditions - such as water shortage - for establishing permanent institutions; and nomadic movements of scattered populations.

Because of the difficulty of contacting people in these circumstances, consideration has recently been given to the use of mobile education units. A one-man mission, financed by the Canadian Government (CIDA), has recently investigated this; and it is proposed to set up a single unit to start with. Opinions at the Ministry favour basing this unit at Laisamis in Marsabit District, from where it could serve a large area including parts of Samburu District.

Education at this level, whether from permanently based FTCs or from mobile units, is felt to have great potential and to be deserving of the fullest support. One of the attractions is their versatility in being able to handle a variety of courses to suit the diverse needs of the people; in particular their important link with women's training.

As pointed out in the previous FAO report (6), instructors in this work should be familiar with teaching and extension methods, particularly in use of visual aid equipment. The teaching of adult pastoralists, many of whom are intelligent and skilled within their own environment - though perhaps illiterate - is one of the most difficult forms of education, requiring careful preparation and imagination. It is therefore suggested that this facet should be included as an item in comprehensive grassland production curricula for all academic streams up to university standard, and visits to FTCs could well be a part of practical programmes.

An important teaching aid for adult classes is the use of colour film transparencies coordinated with suitably prepared short talks on selected subjects. The impact is all the greater if the pictures depict familiar local scenes and people, and the building up, storing and catalogueing of film slide sets should, it is thought, be a priority task for course organizers. A number of slide sets are already available at the Agricultural Information Centre in Nairobi; some having been in use at Giriftu.

In the belief that where favourable localities can be found, FTCs are likely to prove more effective than mobile units, it is recommended that the number in Kenyan pastoral areas should be increased by at least two Centres as a matter of urgency. Mobile units should be used only where there is no satisfactory alternative, or as complementary to the FTCs.

The cost of a 30-bed FTC, including all equipment; administrative and catering facilities, was quoted in 1971 (6) as roughly about K. sh. 117 000 /-. Steep price rises in recent years could at least have doubled this figure.

11. <u>In service training</u>

In-service training may be for one or a combination of several reasons including:

(a) status upgrading linked with pay increase;
(b) ad hoc instruction for a particular purpose such as use of visual aids or teacher training;
(c) refresher courses for:
    (i) revision and imparting of new information;
    (ii) discussion and information from field to lecturing staff;
    (iii) course assessment to gauge the effectiveness and relevance of current curricula, using field experience as an index;
    (iv) general exchange of views, pinpointing areas for action.

It is axiomatic that no single pastureland curriculum can be framed - whatever the standard - so as to meet all job requirements for all the participants. Probably the best that can be hoped for is to achieve a fair degree of relevance for the majority of students, because of the diffuse nature of this subject. For this reason periodic refresher courses or seminars are essential for additional instruction, up-dating, exchange of views, and for helping to keep lecturing staff in close touch with field requirements.

The mounting of such courses involves a lot of time and expense, in which external specialists can often play a useful part with the added advantage of providing much extra information and interest. The six-week international courses initiated by FAO/SIDA (4) are a case in point, in which extra training has been given without involving local lecturing staff in sole responsibility for organization.

The number of refresher courses given in recent times is not known, but there is probably a need for an increase in this area of training.

Normally, such instruction/discussion is timed to coincide with holiday periods at the major institutions. Generally, it is inadvisable to continue sessions for too long: two, or at the most three weeks, is suggested as about ideal for within-country courses or seminars, as staff usually cannot be absent for longer, and interest wanes.

It is suggested that as official policy , all middle and senior grades of field, research and teaching staff engaged in pastureland production be invited to attend regular 'workshop' seminars at suitable centres for not less than two weeks at least once every three to four years; if possible involving outside agencies.

The organizing, timing, cost, subjects and other details should, it is felt, be a matter for early consideration and planned action in a separate study on in-service training.

12. Extension services

The Extension and Training Division of the Ministry of Agriculture is comprised of two branches :

(a) Staff training services (manpower development branch)

(b) Extension information services.

The latter comes directly under the jurisdiction of the Extension Services officer at the Ministry of Agriculture who includes within his portfolio the Agricultural Information Centre (AIC), situated at the National Agricultural Laboratory and headed by the Senior Agricultural Information Officer.

The AIC at present operates through a number of media to gather and convey information.

In summary, these are:

(a) Radio

A programme goes out daily mainly describing interviews with government field officers and research workers.

(b) Mobile information units (cinema vans)

Five of these are presently in service and three more will be commissioned shortly. Each vehicle, with its driver and film operator, goes out for two weeks each month except during rainy seasons. Roughly half the time is spent in pastoral areas and half in farming districts.

While on visits to range areas, films are shown in the more remote places, avoiding markets.

During daytimes the loud-hailer system can be used for addresses at market centres.

District Range Officers are responsible for arranging and publicizing itineraries and for using the facilities.

The aim is to try and visit areas of major ranching importance not less than twice annually. The coverage is therefore somewhat superficial, and the operation of the pilot mobile education unit described in Section 10 is not expected to conflict with these since it will work within a more limited area and at greater technical depth. The AIC at present has a total of about 15 films on pastureland subjects.

(c) Printed technical hand-outs

Originally 18 handouts on pastureland production were available but these are now out of stock. It is intended that staff of the R.M. Division and range research will draft new material during 1977.

(d) Posters

None available on range subjects; and in any case these are thought not to be very effective.

(e) Slide sets

Said to have been recently used only at Giriftu in relation to range training.

(f) Newspaper articles

AIC plans to make greater use of the press. At present weekly articles on general agricultural and ranching topics appear in 'Taifa'(The Nation).

The Information Centre is to be expanded and a new building will shortly be constructed, with facilities for holding two-week, in-service training courses in the use of visual aids and communication techniques for groups of 20 people. These will be drawn from a number of ministries and will include range personnel. Instruction will be under the Visual Aid officer. The new centre will also have a publications section under the Publications Officer who is responsible for arranging, preparing and distribution of written material.

The staff also includes an Information officer, who arranges scripts for radio broadcasts and the press.

The infrastructure already exists for an effective extension drive in pastoral development. Unfortunately, however, the teaching material for such a drive is still largely lacking. While radio and press articles, and visits by the mobile information units can make a useful contribution these are unlikely, without considerable backing and action in other ways, to bring about some of the fundamental changes necessary for a genuine move towards greater ecological stability. Because of the generally low levels of school education, distribution of technical handouts on range management subjects may not make much impression, although they can be very useful in some circumstances.

This leaves education centres, either Farmer Training Centres or Mobile Education Units, as the other major channel open to the AIC through which it can use its equipment in a concerted effort with teaching, research and field personnel, to promote change towards the proper use of natural resources. In addition to the present extension media - which should of course be continued - it is suggested that a greater effort should be made towards supplying the FTCs as well as the mobile units with more teaching material in the form of slide sets and prepared narrative outlines.

Some of the technical films that are being used in the mobile units have little more than entertainment value, though a few are good. The making and copying of films is very expensive and it is suggested that they should gradually be phased out, apart from necessary entertainment to attract viewers, in favour of slide sets which can be coordinated with pre-taped or oral talks given in the vernacular by trained operators.

Useful advice about educational films and slide sets, with costs, is contained in the FAO publication. (6). Referring to slide sets this states :

"The procedure should be to select the subject, write the narration, and then take photographs to illustrate each part. The narration is then recorded on tape and synchronized with the pictures."

The photographs for several different narratives can be taken concurrently. It is suggested that outside aid might be sought for a separate project designed to build up and promote the use of the library slide sets and taped narratives at the AIC: specifically aimed at pastoral development. In 1971 there were 11 sets available and it is not known whether these have been added to.

13. Channels open to pastoralist participation in decision-making

Apart from political channels, some of the ways in which pastoral people can express themselves in decision making are :

(a) At 'ground level' :

i) through contacts between individuals and various government officers;
ii) through Group Ranch committees where members are elected by the group;
iii) through elected graziers' committees representing people in the grazing blocks;

(b) At District level:

through the District Agricultural Committees (DACs) or District Development Committees (DDCs) which may include non-government members.

(c) At Provincial level :

through Provincial Agricultural Boards (PAB) consisting of representative DAC members. PABs may include ad hoc participation from the private sector.

(d) At National level :

through the Central Agricultural Board (CAB), chaired by the Minister of Agriculture, and attended by PAB representatives. There is generally no private sector participation at this level.

14. Summary of impressions and suggestions - Kenya

(a) Kenya has the great benefit of administrative structures which allow for high-status recognition of pastureland production, and for coordination of related development activities. These structures within the Ministry of Agriculture are :

(i) The Range Management Division.

(ii) The Extension and Training Division.

(iii) The Research Division.

(b) There appear to be no complete or reliable forecasts of future staff requirements for pasture-trained people at all levels in the public and private sectors.

Accurate, annually revised, forecasts are necessary for planned training, which should also if possible allow for accommodation of non-Kenyans.

(c) Courses leading either to a B.Sc. degree or M.Sc. in Range Management have been under consideration at Nairobi University.

Graduate training in this subject in Africa is considered to be a desirable development. The writer favours the early establishment of B.Sc. courses with M.Sc. and Ph.D. courses open later for advanced degrees.

(d) The start of degree courses in Range Management in Kenya will entail re-appraisal of both the Egerton diploma and AHITI certificate courses: possibly with a shift towards more practical orientation. In that event, a change of policy in the certificate and diploma training is recommended (Section 9.2).

(e) The three Farmers' Training Centres (two Government and one Church administered) are concerned mainly with adult training of pastoralists. They provide an essential service which should be extended. It is suggested that their number should be increased by the building of at least another two centres as soon as possible.

(f) It is noted that an exploratory mobile education unit has been proposed for work in NE region.

(g) In-service training appears inadequate. Regular working seminars with involvement of external agencies are proposed.

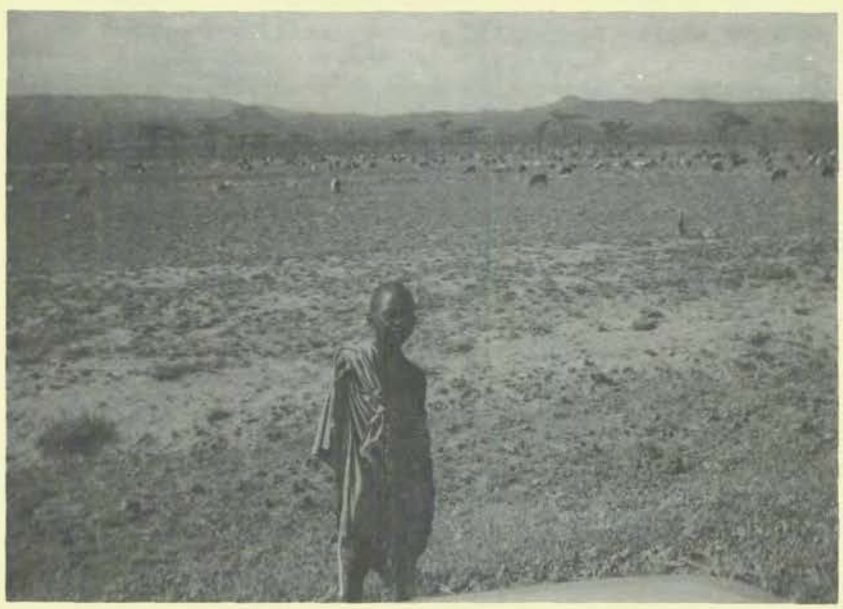
(h) The Extension Services are well established but teaching aids for instruction in pastureland production - especially in the dry areas - are deficient. It is recommended that consideration be given to setting up a separate project for building up sets of coloured slide transparencies, synthronized with taped narratives aimed at the teaching of adult pastoralists and their wives.

The nucleus of a 'slide set' library already exists at the Agricultural Information centre.

(i) Some channels open to pastoralist participation in decision-making are described.

KENYA: View of main entrance to Nairobi University
Faculty of Agriculture

People like these
↑
Must learn to serve
↓
People like this



KENYA: Maasai shepherd lad in typical
pastoral country

III. BOTSWANA - CURRENT PROGRAMMES

15. General Information

15.1 People contacted

Date	Name	Title	Place
17.1.77	Mr O. Svennevik	Resident Representative	UNDP Gaborone, P.O. Box 54
"	Mr N. Buck	Coordinator of Animal Production and Range Research	Animal Production Research Unit, Ministry of Agriculture
"	Mr D. Pratchett	Pasture Agronomist	idem
"	Mr J.A. Milne	Principal, Botswana Agricultural College	Ministry of Agriculture, Gaborone
"	Mr E.K. Maloiso	Vice Principal, Botswana Agricultural College	idem
"	Mr R. Kukler	Director of Field Brigades	Brigade Section, Ministry of Education, Gaborone
"	Mr V. Gibberd	Farming Coordinator, Field Brigades, Serowe	Gaborone
"	Mr R. von Kaufmann	Head of Livestock Project Preparation Team	Ministry of Agriculture, Gaborone (Division of Planning and Statistics)
"	Mr S.D. Ramahobo	Chairman, Livestock Project Preparation Team	idem
18.1.77	Mr R. Purcell	Agricultural Economist	Ministry of Agriculture, Gaborone
"	Mr D. Finlay	Permanent Secretary, Education	Ministry of Education, Gaborone
"	Mr F.S. Alidi	Ag. Chief Land Utilization officer	idem (Division of Land Utilisation)
"	Mr D.A. Sims	Land Development Officer	idem
"	Mr K.S. Bingana	Chief Animal Production Officer	idem (Animal Production Division)
19.1.77	Mr J. Jenness	Programme Coordinator of Tribal Grazing Land Development	Ministry of Finance, Gaborone
"	Mr D. Ritson	Staff Training Coordinator	Ministry of Agriculture, Gaborone
"	Mr L.N. Kingshotte	Agricultural Extension Adviser	idem
"	Mr M. Segkoma	Deputy Permanent Secretary	idem
"	Mr B.S. Tlale	Deputy Director of Agricultural Field Services Division	idem
"	Mr S.S. Gaadingwe	Principal, Denman Rural Training Centre	Gaborone
"	Mr N.E. Matseba	Agricultural Supervisor, Denman Rural Training Centre	Gaborone
"	Dr Makhurane	Acting Rector of University of Botswana and Swaziland (UBS) Botswana College	Gaborone
22.2.77	Mr D. Field	Range Ecologist, Land Utilization Division of Ministry of Agriculture Gaborone	at FAO Hq, Rome

15.2 National statistics

The land area of the country divides into three categories (52) :

	Km^2
State Land	270 630
Tribal Land	281 570
Freehold Land	29 530
Total area	581 730

The tribal land area may, when seen in relation to current development plans, be subdivided into a further three categories:

(a) Communal land
(b) Commercial land - i.e. tribal land which is being planned for ranch development under the Tribal Grazing Land policy.
(c) Reserve land to be held for possible later development

Present land use in Botswana, which is comprised of 10 administrative districts, has been categorized as :

	Percentage of total
Arable land	2.3
Fenced grazing	5.0
Unfenced grazing	70.6
Forests	0.6
National parks and game reserves	17.3
Swamp and open water	4.1
Urban and industrial	0.1

National herd totals, estimated in 1974:

cattle	2 855 000
(thought, 1977, to be probably well over 3 m)	
sheep	420 000
goats	1 350 000

Cattle population is increasing very rapidly due largely to opening up new areas by recent large-scale borehole construction.

Estimated average annual rate of herd increase	6%
Approx. contribution of stock products to GDP	19%
Approx. contribution of stock products to total exports	45%
Country total of human population (1974) 700 000	
Estimated annual rate of national population increase	3%

15.3. General information

Rainfall : varying from about 650 mm annually in a small part of NE to 250 mm in SW.

Nearly the whole country is therefore semi-arid or arid pastureland; although there is a considerable potential for farming in some parts.

Soil: light erodible soils over much of the ranching country; "sandveld".

Vegetation: varying from open grassland to bushland and woodland; existing in a delicate ecological balance with grazing animals, and for the most part extremely vulnerable to overgrazing.

Water: a major constraint to ranch development. Borehole construction has proceeded rapidly recently but is now strictly controlled. There is a recommended five-mile minimum distance between wells.

Vast areas of the country are without surface water.

Land use: the tribal lands are mostly communally grazed. There are as a rule no fences or boundary demarcations between borehole (cattle post) units; and the animals are generally not herded.

Destruction of vegetal ground cover is widespread in many areas due to overgrazing, resulting in bush encroachment and sheet erosion on an increasing scale, especially in Eastern parts of the country.

Tribal Land Boards, under the Ministry of Local Government and Lands, have overall authority for land allocation and use; working through District Lands Officers. These are being supplied with data during the present large-scale project to organize ranch development by "Sandveld Survey Teams" consisting of expatriates with support staff. The DLOs work with advice from Land Utilization Planning Advisory Groups.

This work in connection with the Tribal Grazing Lands Policy is proceeding in three main stages on a district by district basis :

(a) Preliminary survey, including rough soil/vegetation reconnaisance leading to area identification of the three land categories mentioned in 15.2; accurate location of ownership; location of settlements and arable areas. Aerial photography is used.

(b) Demarcation of individual ranches of approximately 6 400 ha within the 'commercial' category.

The presence of Basarwa (bushmen) who live in scattered communities, causes some problems as their rights must be considered. Account must also be taken of game concentrations.

(c) Issue of leases to the ranchers.

15.4 Administrative organization

Devolution of authority within the Ministry of Agriculture's administrative structure is :

(a) Minister of Agriculture
(b) Permanent Secretary, having direct responsibility for :

i) Establishment
ii) Livestock Project Management Unit
iii) Finance
iv) Planning and statistics

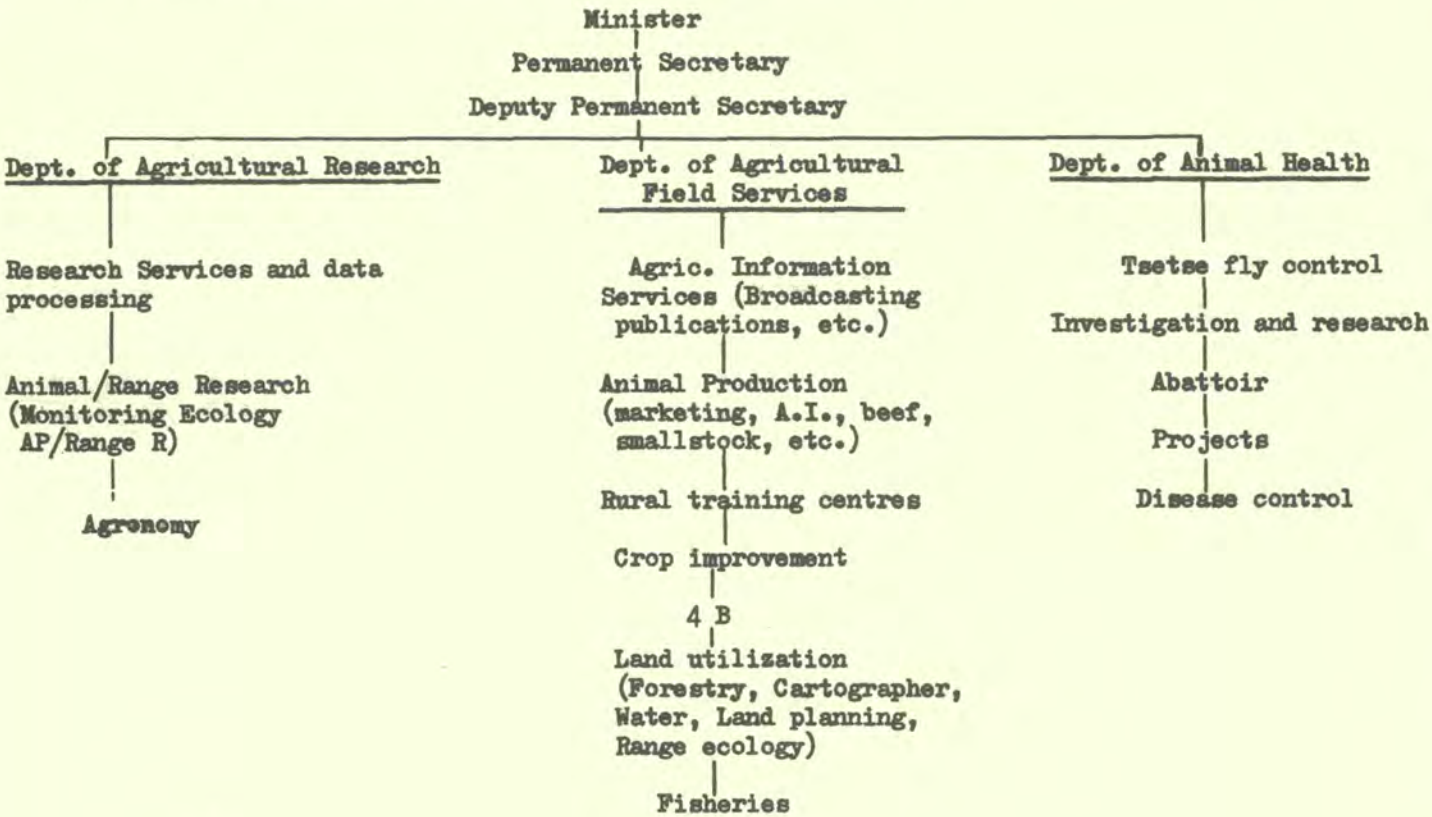
(c) Deputy Permanent Secretary, having direct responsibility for :

i) Botswana Agricultural College
ii) Cooperative development

(d) Rural Sociology and Staff training are also separate sections coming under the Deputy Permanent Secretary.

(e) All the other services of the Ministry, excluding those listed above, come under three major Departments as illustrated in Figure 2.

Figure 2 : Organization within the Ministry of Agriculture, Botswana



Work connected with pastoral development and ranching is fragmented amongst a number of departments, not only within the Ministry of Agriculture, but also between Ministries. There is no single coordinating body responsible for grassland production affairs as a whole. This appears to be a major weakness in the organizational structure; all the more suprising in a country where the semi-arid pasturelands are by far the single most important resource. A separate Department or Division totally responsible for these lands would, it is thought, provide the necessary voice within the government to speak specifically for grazing land and conservation management and for all pasture-related services. Such a Department could especially coordinate and streamline administrative procedures and planning connected with development projects in this field.

The country is divided into six 'Agricultural' regions, five in the populated Eastern areas and one in the far West; each administered by a Regional Agricultural Officer (University standard) with a number of District Agricultural Officers (diplomates) under him, and with Agricultural Demonstrators (Certificate standard) working in turn under the District Agricultural Officers.

The Agricultural Regions and the 'Districts' within them do not synchronize with the ten administrative districts mentioned in 15.2, and should not be confused. The present total of 'Agricultural Districts' within the six regions is about 26.

It is planned to build up the Regional units to include Ranch Development Officers whose duty will be to give technical advice to ranchers by working through Agricultural Demonstrators. Some coordination will no doubt be needed between these and the proposed Service Companies and Monitoring Teams described in the next section.

15.5 Tribal Grazing Land Policy

The chief development drive in Botswana at present centres on the planning (Section 15.3) and development of commercial and 'group ranching'. Details of this are available in a document prepared by the Ministry of Planning and Statistics (19). The underlying purpose is not only to improve the country's economy but to establish an ecologically more stable and land-conservative situation by moving from the traditional 'cattle post' system towards commercial ranching. The programme is summed up in the following quote :

" The Tribal land grazing policy is a programme of major significance to Botswana. Through a fundamental change in the existing system of land use, it aims to reduce the progressive deterioration of rangeland which arises from uncontrolled communal use of grazing areas by increasing numbers of animals. The policy will encourage the introduction of improved ranch and range management systems including fenced areas and exclusive land rights".

Both individually owned and communal cattle posts will be included. The former are to be developed as commercial ranches, and therefore having a potential for coordinated use. The latter will be developed as communal grazing units leading to controlled use if the problems of stock population control can be solved.

The commercial ranches of approximately 6,400 ha will centre around a single permanent water service (generally borehole); and should not carry more than about 400 animal units based on an estimated average grazing capacity of 16 ha/animal. Obviously a major problem, and probably the single most important one from the viewpoint of land preservation and ultimate success, will be to persuade ranchers to limit stock numbers to grazing capacity.

It is proposed to set up a series of 'Service Companies', each to serve groups of 12-15 ranchers and to be supported financially by them. Each Service Company will be under the charge of a manager. It will have a Finance Officer whose work will be to supervise the capital loans to the individual ranchers for development. This is expected to include some fencing. One of the main Service Company functions will be to assist with borehole maintenance, as well as other aids which the small ranch units could not afford individually.

It is anticipated that about 12 Service Companies, serving a total of approximately 150 ranches, will be set up in the initial phase.

The project will be linked with a Monitoring Team operated from the Ramatlabama Ranch Management Centre and consisting of three officers :

Farm Management Economist
Animal Production Specialist
Ranch Agronomist

Their duties will, inter alia, be to monitor the Service Company ranching complex, providing feedback to the executing agencies. They will also train service company managers and finance officers for the new companies. This aspect, together with a training programme for the individual ranch managers is detailed in Section 17.

This important project has been mentioned here with a few details as it will no doubt have a far reaching effect on the country's economy, directly and indirectly influencing future training needs.

15.6 Animal Production Research Unit (APRU)

The APRU has an important influence on development of the livestock industry through research in both animal husbandry and grazing land management. Its interest in training includes : (i) regular refresher courses held at Denman Rural Training Centre (Section 18) for up-dating field staff in research progress and results; (ii) farmer training courses held at the six Short Course Centres situated on their network of cattle breeding ranches; and (iii) the work of the Mobile Field Units. Since the APRUs primary interest is in animals, pasture management tends to receive secondary attention.

The Research Unit has pointed out that an improved cattle management system can yield well over 100 percent increase in productivity, and they state :

"To achieve this doubling of production requires acceptance of the following :

(1) Land enclosure with a degree of internal fencing for preservation of dry season fodder, control of breeding seasons, and physical weaning of calves.
(2) Attention to disease control by the regular adoption of prophylactic vaccination programmes and mineral supplementation with bonemeal and salt.
(3) The provision of adequate and regular water supply".

A fourth item could well have been added to the effect that there can be no increase in livestock production, and the introduction of improved breeding stock may even prove deleterious, unless stocking rates are correctly adjusted to the grazing capacity of the pastureland.

In reference to timetables for in-service training of teaching staff, APRU is reported to have begun work on preparation of notes for use at the Rural Training Centres and Short Course Centres, on a variety of topics. Each set of notes will suggest the demonstration visit or practical work accompanying the lecture and visual aids are to be supplied.

15.7 Forecast of staff requirements

The following institutions (excluding the Extension Services) either do, or could, serve the pastureland training needs of Botswana :

a) University of Botswana and Swaziland (UBS) -
open to candidates having suitable qualifications from Botswana, to attend the course leading to the B.Sc. Degree in Agriculture. Situated at Luyengo in Swaziland. (See Part IV).

b) Diploma in Agriculture also offered at UBS, Swaziland, to candidates from Botswana Agricultural College (BAC) who have attained a credit or distinction in the Certidicate course at BAC. (see Part IV).

c) Botswana Agricultural College:
Certificate courses in Agriculture; Animal Health; Community Development. (Section 16.)

d) Ranch Management Centre, Ramatlabama :
One year courses for ranch managers connected with Tribal Grazing Land Development project: also three-month courses for Service Company Managers and Finance Officers (Section 17).

e) Rural Training Centres (RTCs); and Short Course Centres (SCCs). Short courses for in-service staff and farmers (Section 18).

f) Brigades:
Courses on various subjects: artisan-type training, including general agriculture (Section 19).

The following figures, referring to staff needs at degree, diploma and certificate levels, have been extracted from a recent forecast of manpower requirements in the agricultural sector of the civil service.

PR Scale, including Superscale (Degree posts)

	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82
Establishment Register	102	110	116	119	123	127
Net posts available to Baswana (allowing for attrition through resignations, retirement, and promotion)	82	91	92	82	73	71
Expected recruitment	0	5	14	13	7	10
Number of Baswana (still) required at end of year; i.e. the expected shortfall	82	86	78	69	66	61

T.1.2.3. Scales, Diploma in Agriculture

Establishment Register	95	106	117	127	136	144
Net posts available to Baswana (allowing for attrition through resignation, retirement and promotion)	43	61	66	77	81	79
Expected recruitment	0	14	6	12 (est.)	16 (est.)	16 (est.)
Number of Baswana (still) required at end of year; i.e. the expected shortfall	43	47	60	65	65	63

T.4.5. Scales, Certificate in Agriculture

Establishment Register	398	398	403	408	414	420
Net posts available to Baswana (allowing for attrition through resignations, retirement, promotion)	66	57	57	56	56	56
Expected recruitment	27	27	27	27	27	27
Number of Baswana (still) required at end of year; i.e. the expected shortfall	39	30	30	29	29	29

Although it is not possible to compartmentalize the figures, it may be assumed that pasture-related manpower will be proportionately below requirements, and there is therefore a need for accelerated training in all grades.

A basic problem underlying all manpower needs is the present inadequacy of the educational system to supply school leavers of high enough standard in sufficient numbers to take advantage of opportunities for advanced learning. Unfortunately, agriculture has a lower motivation rating than many other disciplines. The school's education structure from Primary level upwards requires enlarging. It is encouraging that this has recently been the subject of a major Commission.

Because of the scarcity of suitable candidates, the problem may be ameliorated, but not solved, by sending students for training abroad.

16. Certificate courses

Details of training given at the Botswana Agricultural College (BAC) are :

Certificate in Agriculture
Certificate in Animal Health
Certificate in Community Development

Both male and female candidates may apply.
Situation of college : Content Farm near Gaborone
Farm area: 1,200 ha
Duration of courses: 2 years
Annual intake: 30 students
Course objectives: to provide a broadly based training which will equip the participants to enter a variety of fields within the agricultural sector, but mostly within the Ministry of Agriculture. Adaptability is essential. A few may enter private employment.

Training details: courses consist of six terms, each about ten 'teaching weeks' excluding examination time and holidays. At least half the time is given to practical work. The available teaching time with a five-day week and a seven-period day is 350 hours a term or 2,100 hours course total.

Range and Pasture content: A fair proportion of time is spent on subjects relevant to pastoral development. Apart from the animal subjects which are well covered, these include:

	Hours	
	Theory	Practical
Botany	10	20
Seed testing	10	
Communication	30	60
Field administration	120	
Extension	80	150
Social studies (including introduction to sociology; institutions and systems; political systems; social change; education; social problems)	40	
Range management	50	70
Engineering		130
Surveying and soil and water conservation	60	60
Agricultural economics and farm management	60	
Mathematics	10	20
Total	470	510

Total Theory + Practical = 980

This represents about 47 percent of the total course time which may have some bearing on ranching and pastoral development.

The teaching of Range Management specifically, occupies only about 6 percent of the course total and is insufficient for anyone whose work will be in ranching environments. Unfortunately, no exact details of the range management teaching outlines (which possibly differ from the printed curriculum) were available, but probably at least some of the following official curriculum subjects were included :

Range management

Term 3–6	Lecture hours –	50
	Practical hours –	70
		120

Term 3

Introduction (10 hours theory and 20 hours practical)

The economic value of grasslands, social factors influencing range management in Botswana, traditions, beliefs, land tenure, etc. Problems of range management: water distribution, bush encroachment, carrying capacity, communal ownership of grazing lands, overgrazing and undergrazing, etc.

Ecology in relation to range management. Grasses and plants as livestock feeds, collection and study of Botswana grasses.

Suggestions for practicals

Identification of grasses, field trips to investigate grasslands.

Term 4

(10 hours theory and 5 hours per week practical)

Principles of range management – pritical growth periods, collection and study of Botswana trees and shrubs: useful trees, leguminous feeding crops, poisonous plants, trees and shrubs causing bush encroachment.

Suggestions for practicals

Field trips to sandy areas to identify poisonous plants.
Identification of useful trees and trees causing bush encroachment.

Term 5

(10 hours theory and 5 hours practical per week)

Various types of pastures: sour veld, sweet veld and mixed veld (Southern African classification of grassland native, permanent, rotational pastures, etc.

Grazing control systems, influence of water. Effect of fire, possibilities of veld improvement; bush clearing, erosion and its control, fencing, etc.

Suggestions for practicals

Field trips to investigate systems of grazing (e.g. Tlokweng area and government farms, e.g. E.M.U., Tribal farm, e.g. Masama), etc.

Term 6 (10 hours theory and 10 hours practicals)

Introduction to Tribal Land Grazing Policy, the problems of the livestock industry. Lectures from Research Officers (Animal Production) and Land Utilization.

Suggestions for practicals

Reviews of grasses. Useful trees and poisonous plants.

After about two years of field work, students who have attained either distinction or credit may attend the Agricultural Diploma course held at UBS in Swaziland, which takes a further two years. Roughly 12-15 from both Agricultural and Veterinary streams go to Swaziland annually.

The introduction of Diploma training at BAC within the next few years is being considered. Meanwhile, it is probable that the Agricultural Certificate course intake will soon be doubled. When this occurs it has been suggested that the students may divide into separate streams of 30 each with different subject emphasis :

(a) Range management and livestock
(b) General agriculture

Such a development would have advantages as there is undoubtedly a need for greater specialization by some staff in ranching and pastoral development.

17. Ranch Management Centre - Ramatlabama

Mentioned in Section 15.7. Details are :

Situation: the old veterinary school at Ramatlabama in S. Botswana.
Area of land: 500 ha attached to the Centre.
Facilities: Many of the original buildings are available and can quite easily be adapted for ranch training with a few additions - to be financed by the European Development Fund. The present buildings include an AI Centre and there is an abbatoir nearby.

Objectives: the Centre will have two main functions:

(a) to provide staff and amenities for training :

(i) Service Company managers and ranch finance officers
(ii) Farm managers

(b) to provide a base for the Range Monitoring Team whose duties will be to make continuous observations and to supply information on the progress of the Tribal Grazing Land ranch development (Section 15.5).

It is therefore expected that Ramatlabama will supply the major requirement of trained staff for the new ranch complex.

Teaching staff: the Principal will be an experienced rancher, responsible for the ranch manager's course, assisted by three agricultural demonstrators.

The small staff number might prove to be a weakness. Much of the work will have to be done by Agricultural Demonstrators who may themselves have insufficient background knowledge of the pasture subjects. An increase in trained staff could become necessary.

Training programmes (expected to start in 1978) :

(a) Service Company managers and Finance Officers - who may be BAC certificate holders - will enter in groups of three, for 'on-the-job' training during three-month periods only. There will be a maximum of two such sessions annually, either for groups of three SC managers or three finance officers, depending on the demand.

During the three-month sessions, each trainee will accompany one member of the Monitoring Team for one month at a time as he goes about his business in both field and office: thus all three trainees will receive instruction from the three Team specialists in Rotation.

There will therefore be no set training as such for the SC managers and FOs, and the knowledge gained during the three months in company with the Monitoring Team will be regarded as a 'topping up' of previous experience.

(b) For ranch managers - candidates will be channelled through RAOs. They need not have had much formal education, and will be drawn from the ranches, at least initially.
The course will be for one year; and the annual intake 25 people.

Most of the work will be done outside and the following curriculum has been suggested, as a guide to start with.

Outline Course Curriculum - Ranch Management

Animal Production

Physiological needs of cattle for optimum production under the varying conditions obtaining in Botswana.
Feeding, breeding, weaning, preventive and curative medecine, diagnosis of common diseases, and stress factors.
Dehorning, castration, ear notching, vaccinating, branding, handling in kraals, crushes and on trek.
Basic genetics and herd breeding policy, herd improvement and inter-breed and crossbreeding comparisons, artificial insemination.
Selection for purchase, sale, culling and breeding including valuation of all classes of stock.
Pre-slaughter evaluation, grading and marketing.

Pasture Husbandry

Species identification, evaluation, establishment and eradication under field conditions.
Plant growth, plant populations and herbage interactions.
Grazing systems, stocking rates, pasture improvement and legumes establishment.
Soil types, mineral deficiencies, water table, surface capping, soil pan formation, heaving, erosion, water logging.

Farm engineering

Maintenance and use of farm equipment such as burdizzo, dose guns, wire strainers, branding irons, ropes, scales, etc.
Maintenance and use of farm machinery such as tractors, trucks, implements, borehole pumps and engines, auxillary pumps and engines.
Construction and maintenance of roads, firebreaks, fences, troughs, reservoirs and kraals.
Safety precautions for labour, range, animals and machinery.

Farm management

Farm recording including that connected with monitoring, accounting, budget, financial appraisal and forward planning.
Rules of ranch business, profit and liquidity.
Debt, loan servicing charges and mortgages in relation to ranch cash flows.
National Development Bank and commercial bank credit facilities.
Ordering supplies and stock control, evaluation of goods and services.
Labour management, hiring, firing, paying, incentives, piece work, handling of dependants.
Buying and selling cattle - marketing.

It would be premature to comment on this outline, which will no doubt be altered in some respects once the courses are underway.

A possible weakness in the Ramatlabama programme may be in the suggested procedure for training SC managers and FOs. It appears risky to depend too much on Monitoring Team members to be able to give sufficient instruction in the time available, and it is thought that more formal instruction may later be found necessary.

Ramatlabama will, through its monitoring function, establish a working relationship with the International Livestock Centre for Africa (ILCA) - so Botswana will by this means contribute to, and benefit from external expertise.

18. Rural Training Centres (RTCs) and Short Course Centres (SCCs)

The Ministry of Agriculture Field Services Department is responsible for all farmer training.

18.1 RTCs

It is intended that each of the five E. Regions shall have its own RTC. At present there are three built and functioning, and two more will be built with British aid in 1979/80. The operative centres are :

Denman (near Gaborone)	- 60 residential places
Mahalapye	- 60 " "
Maun	- 30 " "

To be built :

Francistown and Kanye

Length of courses: generally one week
Fees: nil, except for occasional expatriate groups who use the facilities.
Staff: each RTC has a resident staff, e.g. at Denman, excluding the Principal, Warden and Matron, these are :

2 Animal Husbandry Lecturers
2 Crop Husbandry (dry land) Lecturers
1 Horticulture Lecturer
1 Home Economics lecturer

With the exception of one diplomate, the rest are of certificate grade.

A large variety of subjects may be covered and courses are held to suit current needs at the request of the DOA or other bidders.

External lecturers may be invited to assist with teaching.

In addition to adult and youth (4-B) training at the centres, courses are held externally at a variety of places, on request. The instructional staff goes out, generally in pairs, from the RTCs. Many people are contacted at these external courses and the possibilities for extension are great. A total of about 4,000-5,000 people are said to be contacted annually by all RTCs, who provide valuable backing to the extension services.

Regrettably, very little pastureland teaching is given; nor is it often requested. It is hoped that this will be rectified as soon as it is possible to obtain more teaching staff who have specialized in this subject.

The evident unawareness of the basic importance of pastureland management amongst the general public - with the present heavy emphasis on livestock - will probably only begin to be corrected when BAC and UBS are able to place greater emphasis on pastures in their curricula. This may take place through mounting special courses as now tentatively proposed at BAC in connection with their increased 'certificate' intake.

18.2 SCCs

There are six SCCs within the APRU network of ranches. It is planned that these should be run under the supervision of the Principals of RTCs, who will coordinate the training programmes. Some are already operated in this manner. Extra staff, normally consisting of two instructors, are provided for this work.

The Centres have residential room for 12-15 men or women, and courses run for one week. They are solely concerned with animal production and were built because of the difficulty of contacting farmers through mobile education units, and in response to the need for follow-up after initial contacts made by the mobile units.

The syllabi are of two types:

(a) to present the possibilities of ranching under 'reasonably acceptable' levels of management - given to civic authorities who are responsible for leading the people;

(b) graded courses to instruct people who are already engaged in some form of improved ranching.

Some teaching on grazing land management is no doubt introduced into the 'type b' courses, but the amount of time or emphasis given to it is not known.

In conclusion, it is clear that many of the facilities exist for a balanced ecological approach to farmer training on pasture/livestock production through the RTCs/SCCs and extension services: this can be on quite a large scale. What may be lacking at present is a sufficient awareness amongst teachers of the need for such an approach as well as the basic training required to convey it to the public with sufficient emphasis.

19. Brigades

Brigade groups are under the general supervision of the Ministry of Education but are run by independent Boards. Some finance and staff are provided by Government.

Their purpose is to provide training of artisan type in a wide variety of fields for young people of Primary School grades who have failed to find other openings. There is therefore a very low motivation for entry: school leavers enter only as a last resort and the reject rate is high.

The Brigades however, do provide a valuable service to the community in helping to fill employment niches which are not filled by more advanced institutions.

Their major functions are threefold:

Adult training

Employment - largely self-created

Service

Most of the work is of a strictly practical nature, an important objective being to make money to help in covering the costs.

Initiative to start a Brigade group comes from the people. They must apply to the Government who will support the project if, after examination, it appears viable. Some groups are also assisted by Church organizations. There are at present 14 Brigade Centres in total : the largest centre is at Serowe which runs a beef and dairy farm, with some cropping, on land provided by the Government. A smaller agricultural unit is located at Moshudi.

An advanced two-year course in agriculture is available at Serowe. It is currently attended by nine pupils to whom a certificate of attendance will be given. The Certificate of Attendance does not have the same status or recognition as the BAC certificate.

Roughly 5-8 percent of Range Management subjects are included in the syllabus. These are :

Basic principles of plant growth
Effect of grazing animals on pasture plants
Timing and severity of grazing
Bush encroachment; causes and effects
Types of grazing animals
Fire; effects and control: and others.

The authorities at the Serowe Centre have offered to hold ranching courses with a view to providing low-level practical training for assistants to meet various requirements such as fencing specialists and stock foremen. The trainees will serve the new Tribal Land ranch complex. An intake of about 10-12 candidates is visualized. These would not compete with the Ramatlabama out-turn.

Some money would be needed to improve the amenities for each course and a pre-requisite would be for the management and staff of the Centre's 'ranch' to ensure that their own farming/ ranching operations are of sufficiently high standard for proper demonstration purposes. An estimate of the money needed for this is approximately Pula (equivalent to Rand) 20,000.

So far the Government has not taken up this offer, but it is hoped that it may be reconsidered since these institutions - somewhat similar to 'Isinya' in Kenya - can provide a small though useful addition to Botswana's trained manpower needs.

20. Extension services

Agricultural extension is carried out by staff of the Department of Field Services Agricultural Demonstrators - in which there is at present a high staff/farmer ratio , probably sufficient for the country's present needs.

The Animal Production mobile units - staffed by an Animal Production Officer (diplomate) and an Agricultural Demonstrator - provide extension contact amongst scattered stock owners. Three of these units are now in service, with plans to increase the number to nine soon. An additional four or five may be added later.

Extension amongst farmers and pastoralists is active through broadcasts and broad-based publicity campaigns organized by the Agricultural Information section. The Tribal Grazing Land Policy has been much publicized through the press and radio, and reactions by the public, which have been generally favourable, have been notified to the Government. The public was informed and opinions sought, through a carefully arranged Radio Learning Programme - perhaps unique of its type - organized by the 'Media Coordinator' of TGLP. For this purpose, radios were issued to registered groups of people on condition that they would listen in to the broadcasts; the groups having been formed by extension workers, teachers, or other officials. Regular explanatory broadcasts were then given out, and opinions and questions sent in from the many groups,were indexed and the queries answered in a major public relations campaign.

A monthly bulletin 'Agrinews' containing technical information, is issued free of charge, on request.

USAID is to provide several Beef Development Officers who will also have extension duties - stationed at centres from where they can contact ranchers. These will reinforce farmer training, and will it is thought, be complementary to the work of the Mobile Units. The Beef Development officers will be concerned more with livestock and sociological aspects than with pastureland management, which nowhere appears to be adequately covered.

21. In-service training

Periodic short courses for in-service staff are held at various centres, and service staff are aware of the need for regular up-dating and augmenting of current training programmes. In terms of buildings and accomodation, facilities appear adequate for in-service training on a far larger scale than at present, especially in subjects more closely related to the plant management aspects of livestock production.

The present programmes which receive considerable emphasis by the APRU certainly include an element of 'pasture' teaching, but problems of proper use, and the essential ecological 'balance' between plants and animals will no doubt require much emphasis if the importance of plant life is to be brought home to cattle-raising people whose attention has traditionally been almost exclusively absorbed by their animals.

As previously mentioned, a major constraint appears to be the present shortage of teaching staff who are adequately equipped to deal with this subject.

22. Channels open to pastoralist participation in decision-making

In earlier times, and to an extent also today, the Kgotla (traditional courts) had decision making powers, and were the bodies through which the people would state their views. Disputes were also heard and adjudicated by these courts.

The trend now is now for the District Council to take over the Kgotla functions, providing a more modern forum for discussion.

Village Development Committees, comprising elected representatives, also provide a channel for communication; and the Tribal Grazing Lands Policy was discussed at these in great detail.

The Natural Resources Board, which has responsibility for conservation, amongst other matters, has nominated citizens amongst its memberships. As in all developing countries, the initiative for change generally starts from the Government. In Botswana majority opinion stated through the available channels is not disregarded in official decision making.

23. Summary of impressions and suggestions - Botswana

The following observations, and comments arising therefrom, are made with awareness of the risks after such a short visit.

(a) The absence of a Department or Division specifically to deal with, and coordinate all grazing land development (with proper emphasis on conservation of the irreplacable plant communities) appears to be a major weakness in Government structure. This has an important, indirect bearing on training; apparently reflecting insufficient official awareness of the importance and urgency of preserving the vegetal cover, on which all else depends.

(b) There is a shortage of trained personnel at all levels within the field of Agriculture more particularly of degree and diploma standard. There is a possibility that BAC may initiate a special certificate training programme with greater emphasis on range management. The possibility that agricultural diploma courses may also be started at BAC, in addition to doubling up the certificate course in the near future, is noted. See comments in Part IV, paras. 24.3 and 32 on relevance of Swaziland training to Botswana.

(c) The present BAC agricultural curriculum appears inadequate in its Pastureland content.

(d) The major importance of the Tribal Grazing Land Policy to Botswana's economy and its possible beneficial influence on the future ecological stability of the pasturelands is noted.

(e) It is hoped that APRU may use its resources to give greater emphasis to pastureland management in its future work and extension programmes. The need for relating improved feeding to improved animals requires much stress.

(f) The present plans for providing trained ranch managers, Service Company managers and finance officers, from the Ramatlabama Ranch Management Centre may require considerable modification in the light of experience :

(i) in the published curriculum;

(ii) because of a possible insufficiency in the training programme for the SC managers and the FOs;

(iii) because of the possible need for additional staff well qualified and experienced to teach ranching technology.

(g) Increased adult training appears necessary to promote greater public awareness of the importance of properly managed plants in the ecological chain leading to improved animal yields.

The facilities already exist for this in large degree through the extension services, Rural Training Centres, Short Course Centres, Mobile Extension units, and other media.

(h) A major constraint is the present shortage of well qualified teachers in the principles and practices of grassland production.

(i) In-service staff training in this subject on a greatly increased scale should be considered as soon as qualified teachers become available.

(j) Further consideration should be given to the development of Brigade ranching courses to help in supplying the lower echelons of skilled manpower requirement.

(k) Because of large environmental differences, pastureland training available in Swaziland diploma and degree courses is not closely related to Botswana's needs and is , therefore, partially irrelevant to Botswana students (ref. Part IV).

Figure 3 - Botswana: University of Botswana and Swaziland

View of main block - Gaborone

The Botswana faculty shown here does not at present include Agriculture, which is taught in Swazil:

Botswana: main administrative block of Denman Rural Training Institute

IV. SWAZILAND - CURRENT PROGRAMMES

24. General Information

24.1 People contacted

Date	Name	Title	Place
21.1.77	Mr H. Newlands	SAA/FAO Country Representative	UNDP, B.P.261, Mbabane, Swaziland
"	Miss J. Sims	Deputy Resident Representative	idem
"	Mr D. Bishop	FAO Pasture Agronomist	Ministry of Agriculture B.P.162, Mbabane
24.1.77	Dr A. Khoza	Director of Veterinary Services	idem
"	Mr P. Mthethwa	Under Secretary, ag. Permanent Secretary, Ministry of Agricul.	idem
"	Mr John Menz	Senior Agricultural Economist	idem
"	Mr D. Shamir	Training Officer, Ministry of Agric.	idem
"	Mr D. Khumalo	Head of 4S Youth Section	idem
"	Mr L. Brummer	4S Youth officer	idem
"	Mr J. Presswood	Animal Husbandry Officer (training)	idem
25.1.77	Dr J. Sheehey	Veterinary Education Officer	Veterinary Staff Training Centre, Mpisi
"	Prof. W. Bell	Dean, University of Botswana and Swaziland	Malkerns, Swaziland
"	Prof. A.G. McArthur	Professor of Animal Husbandry, UBS Swaziland	idem
26.1.77	Mr James Watson	Plant Breeder	Lowveld Experimental Station; Big Bend, Swaziland
27.1.77	Mr M. Waller	Senior Land Planning Officer	Ministry of Agriculture
"	Mr R.D. Thwala	Senior Agricultural Officer	idem
28.1.77	Dr N. Fraser	Lecturer in Animal Husbandry UBS Swaziland	Malkerns, Swaziland
"	Dr N. Gumede	Senior Veterinary Officer, i/c Animal Production Division	Ministry of Agriculture

24.2 National statistics

Total land area		17 200 km^2	
Approximate total area of pastureland, excluding rock and unuseable land		11 080 km^2	
Approximate percentage of pastureland (natural or planted) in total country area		64%	
National herd totals (1974) -	Cattle	610 000	
	Sheep	40 000	Equivalent to 63 000 cattle at 5:1 ratio
	Goats	275 000	
Approximate total cattle equivalent =	673 000		
Estimated (1974) overall stocking rate of pastureland (cattle equivalents)		1 head : 1.6 ha	
Estimated annual rate of herd increase		2-3 %	
Estimated approx. average annual offtake from national cattle herd (this should be raised to at least 15% to achieve near stability of herd size)		11%	
Estimated contribution of meat products to total exports (1971)		3%	
Country total of human population (1974)		475 000	
Estimated average annual rate of population increase		3.1%	
Estimated proportion of population engaged in various forms of agriculture		over 70%	

In terms of export value, meat products rank well below other commodities. The value of major exports in 1971, in order or priority, was :

Sugar (irrigated)
Iron Ore
Woodpulp
Citrus fruit (irrigated)
Meat products
Canned fruits

Maize is the stable food and roughly three-quarters of the cultivated land is used for this crop. The standard of farming is low and imports of maize continue at a high level. Forage crops are not grown on any scale. There is considerable potential for dairying, but most of the milk consumed is imported. There appears to be a big potential for feedlot development, making use of the sugar by-products. This could help to relieve the stock pressure. Work has been started on a small 'pilot' unit.

24.3 General information

The Swazi nation, under its King as supreme Head of State, is a traditionally cattle owning people. The social structure is centred largely on individually owned stock raised on common pastureland with all the familiar problems associated with uncontrolled communal use.

The pastureland proportion (roughly 64 percent) contains some potential arable land, which could about double the present cropping area when it is required to provide for the rapidly expanding population. Thus, while the pasture areas will shrink, the stock population, already heavily exceeding grazing capacity in many parts, is continuing to rise. The national herd offtake remains static at about 11 percent or less.

Climatic and vegetation characteristics are illustrated in the following table (26)

TABLE 4 - CLIMATE AND VEGETATION ZONES OF SWAZILAND

Elevation (metres)		Mean annual rainfall (mm)	Natural vegetation
Highveld	1 000 - 4 000	1 000 - 2 300	Upland sourveld
Middleveld	350 - 1 100	750 - 1 150	Tall grass veld
Lowveld	150 - 500	500 - 900	Deciduous bush and tall grass Acacia - Savannah sweetveld
Lubombo	750	600 - 1 000	Mixed bushveld

The Highveld is mountainous country of which only about 10 percent has a fair potential for agriculture. The Middleveld is hilly but has about 30 percent of good arable soils. This is the main farming area.

The Lowveld is mostly gently undulating; hot and rather dry ranching country but with some large areas of irrigated sugar and other crops.

Overgrazed unfenced communal pastures, consisting largely of inferior grasses and showing obvious signs of nutrient deficiency, are typical of much of the Highveld pastureland; while heavy overgrazing and severe soil erosion, with dense bush in parts, characterises much of the communally used Lowveld. There are some large commercial ranches in the Lowveld region.

Only about 55 percent of the country's area is Swazi Nation Land, the remainder being held under freehold title, mainly by expatriates. These 'Title-deed' lands are gradually being acquired on a willing buyer - willing seller basis for inclusion in the Swazi Nation Land areas.

The traditional land tenure system places ownership with the King in trust for the nation. Individual ownership is not recognized on Swazi Nation Land which is divided into Chiefdoms, and each Chief allocates arable plots and a homestead site to each family in his domain while the remaining land is grazed communally.

Some of the 'Freehold' land is well and intensively used, but in other areas which are not effectively occupied because of absentee ownership, much of the pasture is already being communally grazed legally or illegally by Swazi-owned stock. In 1970, cattle owned by Freehold farmers were less than 20 percent of the national herd, and this proportion has probably declined since then.

The transfer of Freehold land, once bought, to Swazi Nation Land raises problems due to the difficulty of establishing user rights. Some of these areas are being used as stock breeding farms in connection with 'Rural Development Area' projects.

The proportion of Lowveld classifiable as ranching country is relatively small, and the broad approach to training advocated in Part I is therefore very applicable. There is a theoretical potential for dairying and more intensive beef production on improved cultivated and fertilized 'mixed farm' pastures in the Middle and Highveld regions. Too much emphasis on semi arid areas in training schedules is therefore inappropriate.

The major focal point of development policy within the 'Second National Development Plan 1973-77' (30), is the establishment of the Rural Development Areas (Section 24.4). The purpose of these is gradually to transform the traditional farming system through introduction of modern techniques involving both crop and pastureland. The plans provide for a degree of stock control on fenced grazing land that represents a transitional form of management between "Uncontrolled communal use" and "Controlled unified use".

All three categories of land use, described in Part 1, Section 3, are therefore represented in Swaziland and this again underlines the need for comprehensive training curricula which should include quite a large proportion of teaching on sown pastures and forage crops, and their place in mixed farm crop rotations. Unfortunately, the needs of Botswana and Swaziland are somewhat incompatible in this and other respects, which reduces the relevance of the Swaziland courses for Botswana students.

24.4 Rural Development Areas (RDA); 'Sisa' Ranches; and Fattening Ranches

24.4.1 RDAs

Traditionally, livestock are grazed communally which gives no incentive to the individual to limit his herd size; rather the reverse. Fencing and rotational grazing of common pastures has begun in a few localities but selective breeding, supplementary feeding and control of stock numbers are virtually non-existent.

The RDAs have therefore been introduced to provide an administrative and technical framework within which the traditional pattern of subsistence agriculture, with communal grazing of livestock, can be reorganized.

Some basic features are :

a) The setting up of a series of separate RDA projects, each under a Project Manager (University grade), assisted by subordinate staff including Agricultural and Livestock Extension Officers, Field officers and others. There is widespread public support.

b) The consolidation of fields into large blocks to facilitate proper soil conservation measures. Most families at present have at least two fragmented holdings. A target of 2,000 ha annually for arable consolidation and conservation has been set for each RDA.

c) Resettlement of families - on new holdings - but still under the Chief's jurisdiction and without legal title to the land. The target is to resettle more than 1,000 families annually on each RDA

d) To fence off the communal pastureland included within the RDA and to start controlled grazing management including limitation of stock numbers. Since the animals will still all be individually owned, it is not clear how the de-stocking will be accomplished. A recent seminar (28) was reluctant to discuss legislation but the concensus was that limitation is essential.

The Sisa Ranches (Section 24.4.2) are thought by some - a view not shared by the author - to offer a solution to the problems of stock population control.

At present, four RDAs have been started in the densely populated Middleveld zone and there are plans for a further 14 new ones to be established, with help from international finance. The whole programme, when complete, will encompass about 50 percent of Swazi National Land.

The projects will take in staff in considerable numbers of degree, diploma and certificate standard. Field Officers will receive training up to certificate level in one-year courses soon to be started at UBS.

24.4.2. 'Sisa'Ranches'

The word Sisa refers to a long-established tradition - common amongst many pastoral peoples under different names - whereby an individual may loan out a group of animals to another who will look after them in return for use of the milk and some of the offspring. It has been agreed to make use of this principle, which is readily understood by the people, through establishing 'Sisa' or breeding ranches to complement the fattening ranches (Section 24.4.3). The 'Sisa' ranches will take in surplus cows from the RDAs and will charge fees for managing and upgrading their progeny with improved bulls. The foundation stock will thus be replaced by improved (half-bred) offspring. Cull cows and steers will be fattened and the proceeds will be credited to the owners, to whom the upgraded females will be returned on request. There may be up to four of these ranches by about 1981.

It is hoped that enough female stock will be sent to the Sisa ranches to correct RDA stocking rates, after which numbers may be controlled.

Questions which arise are :

- How will the upgraded females be provided with the higher plane of nutrition which is essential?
- Do extension officers have the answer to this feeding problem?

It is well known that improvement of stock quality without a corresponding rise in the plane of nutrition can be a sure recipe for failure. The development of dairying on RDAs will be assisted by a Canadian Dairy Project based at Manzini.

24.4.3 Fattening Ranches

These take in cull stock from the RDAs to improve their marketing quality. They are not intended to solve the overstocking problem. At present, there are three FRs : two more may be needed by 1981.

24.5 Administrative organization

The Ministry of Agriculture structure at the time of the visit was summarized as :

(a) Minister
(b) Permanent Secretary and Undersecretary
(c) Divided into three major departments :

Administration
Extension
Veterinary Services

(d) Sub-divided into a number of separate units or divisions :

Land valuation)
Land planning) under the PS/US, associated with
Economic planning and Economics) the Administration

RDA Management Unit)
Senior Agricultural Officer) under the Director of Extension

Livestock Services (Animal Production Division)) under the Director
Veterinary Services (Animal Health Division)) of Veterinary Service

(e) The field extension services :

Land Development, Crop Extension and Livestock Extension operate through District Extension officers working both in the RDA and non-RDA localities.

(f) The Veterinary Services Division works through its Veterinary Officers and has a functional relationship with the Livestock Extension section.

As in Botswana, a striking ommission is the absence of a Pastureland Production unit within the Government Organization. Considering that the Swazi Nation are a traditional cattle-owning people depending quite largely on their grassland/bushland which represents a major natural resource (about one-third of the total land area, as yet undeveloped), this is an obvious weakness in the Government machine. Typically with pastoral peoples, the concept of pasture as a crop which will respond to care and management, requires emphasis. Of major importance therefore, is the presence within Government of a specific unit which can represent the needs of this important crop in all its aspects, especially in regard to finance and staff for education, research and extension. Without such a coordinating high-level authority which can press for the proper recognition of this valuable but wasting resource, rapid progress can hardly be expected.

Reorganization within the Ministry of Agriculture to provide for this is therefore strongly recommended.

24.6 Forecast of staff requirements

No comprehensive estimate of future staff requirements in all fields related to pastureland production is at present available. There is however, an obvious need for nationalization of the many senior posts within the Ministry which are at present filled by expatriates.

The school system has so far failed to turn out young people of high enough standard, especially in science subjects, to take advantages of the opportunities open for advanced education. Efforts are being made to correct this.

The following projections of personnel in the RDA Field Extension Service and the Animal Production Division give some idea, though incomplete, of future requirements. All these staff members, as well as those in other sections not recorded there, should be in a position to assist in the necessary major drive for better pasture use. Each of these persons should have a good basic understanding of grazing land management through well-balanced training programmes. Regrettably, this will not be the case, and cannot be expected because the general level of pasture-related training at all institutions visited is grossly inadequate to meet this requirement, with the possible exception of the Diploma in Animal Health and Management offered at the University.

TABLE 5 - RDA FIELD EXTENSION WORKERS

Total posts filled 1976/1977	Total posts to be filled 1979/1980	Increase total posts
64	139	75

Thus it is evident that more than a doubling will be required within the next three years, owing to the RDA development, after which the projections level off. An exact breakdown of the different academic standards required is not known, but roughly two-thirds of these should be certificated.

TABLE 6 - ANIMAL PRODUCTION DIVISION - 1977-1981

Allowing for 10 percent attrition amongst the diploma and certificate levels, and 30 percent wastage of graduates, estimated requirements are :

	Approx. per year	Total for 4 years
Graduate	6	24
Diploma	15	60
Certificate	6	24
Total	27	108

The figures in these two samples indicate an urgent need for an increased out-turn of the trained Swazi staff of all grades. The preparation of a consolidated projection of all staff needs in all Sectors of the different academic grades is a vital necessity without which it is impossible to make proper training plans.

25. Degree Training (31)

The Agricultural Faculty of the University of Botswana and Swaziland (UBS), situated at Luyengo near Malkerns in the Highveld serves both Swaziland and Botswana for Degree and Diploma courses in Agriculture. The university farm is 315 ha; with a research station, which includes some pasture research nearby.

The entry requirement for courses leading to the Degree of Bachelor of Science (Agriculture) is a pass, with credit in mathemetics and English language, in the Cambridge Overseas School Certificate, or its equivalent. Part 1 (two years) is undertaken in the Faculty of Science, during which courses are taken in Biology, Chemistry,Geography, Mathematics, Physics and English. Students must pas Part 1 before admission to Part 2 (Agriculture) for a further two years. There are 20 places available annually some of which may be filled by students from other countries.

The Part 2 studies include :

Crop production

- Plants of Agriculture
- Introduction to Crops
- Plant Physiology I and II
- Crop management
- Crop Physiology
- Crop Breeding
- Plant Propagation
- Entomology and Plant Pathology
- Crop Case Studies
- Crop Protection
- Agricultural Experimentation and Statistics
- Biochemistry

Animal Production

- Animal physiology
- Animal breeding
- Animal nutrition
- Animal ecology
- Veld Management
- Animal Health and Hygiene
- Animal Husbandry

Land and Climate

Climatology and Hydrology
Soil and Water
Conservation
Irrigation
Agricultural Mechanization
Surveying
Soil Science

Agricultural Economics

Agricultural Marketing
Agrarian Extension
Farm Business Management
Agricultural Policy
Agricultural Development

Land use planning and Agricultural systems

Miscellaneous

Degree seminars
Farm briefing
Dissertation

While recognizing that this is a general agricultural course in which emphasis must be on farm crop production, it will be seen that the course is quite insufficient in its 'pasture' content to meet the urgent needs of improved pastureland use in Swaziland, and certainly totally inadequate in relation to the development of Botswana's major resource through the ranching and pastoral development projects.

Details of the Veld Management course, given in the third 16-week semester of the final year, are :

Veld Management Course: UBS Degree B.Sc. (Agr.)

Time allocation:	16 hours theory 32 hours practical
Course outline:	Botanical Surveys Bush clearing Erosion and its control Fencing Water supplies Grazing and stocking rates Veld fires - their use and misuse Ecology including wildlife Veld improvement Poisonous plants Edible plants

Expansion of this particular course deserves consideration even though pastures are not a major subject.

Clearly there is a need for review of the whole course structure if grassland production (including Range Management) is to be sufficiently well provided for in UBS Degree training. At present it is hardly touched, and authorities requiring people to be taught in this subject would be well advised - unless there is a radical change - to send students elsewhere for a more thorough grounding.

26. UBS Diploma Courses

Two year courses are offered leading either to the Diploma in Animal Health and Management, or to the Diploma in Agriculture. The AH and M diploma has openings for 20 candidates annually, and the Agriculture diploma for 30 candidates. The AH & M curriculum includes 32 lectures and 45 hours' practical work in Forage and Pasture Agronomy; having the following course outline :

FORAGE AND PASTURE AGRONOMY: UBS DIPLOMA IN ANIMAL HEALTH AND MANAGEMENT

Time allocation — 32 hours theory
45 hours practical

Course outline :

The World's grasslands - natural and improved
The growth of pasture plants
Grass species and their identification
The establishment of improved pastures
Pasture plant nutrition and nutrient cycles
The feeding value of pastures
Grazing management of improved pastures
Veld management
Pasture conservation

A course in Ranch Management (Farm management) is also taken by the AH & M students, having the following outline.

Ranch management: UBS Diploma in Animal Health and Management

Time allocation — 48 hours theory
48 hours practical

Course outline:

Objectives

Commercial ranch
Fattening ranch or holding ground
Breeding ranch
Way of life/traditional

Resources

Land
Labour
Capital

Definition of management

Planning, execution, control

Valuations

Livestock, Land; Improvement; Chattels, Stocks on hand

Carrying capacity

Livestock Unit system (LSU). Feed supply and demand

Stock reconciliation

Planning

Aim; Formulation; Budgeting

Control

Budgetary control. Concept of fixed, variable and marginal costs

Analysis

Gross margins; whole farm analysis; enterprise analysis

Managing for Improvement

Buildings, fencing, roads, water supply, dip tanks, cattle yards and handling facilities.

Design, siting, estimating supplies, ordering supplies and general construction procedure of these improvements.

Labour

Amount, organization, supervision, training, work study.

Managing a feedlot

Office procedures

General, Keeping of Records, Inventory and stock control, Budgetary control, Report writing.

It will be seen that, within these two courses, the AH & M Diploma students receive a combined total of 80 lectures and 93 periods of practical work in subjects pertaining to pastureland production.

In contrast to this the Agricultural Diploma course receives only 12 hours of theory teaching in the subject of 'Pasture and Fodder crops', with no practicals. The course outline is similar to that shown for the AH & M stream.

The Diploma training in Animal Health and Management is, therefore, far more relevant to pastureland development both in Swaziland and Botswana than is the Agricultural Diploma.

At the time of the visit there was no specialist in grazing land management on the staff, but a post was being advertised.

27. UBS Certificate courses

It is planned to start certificate courses leading to the Certificate in Agriculture in May 1977, for an initial intake of 40 trainees. These will be held within the UBS Agricultural Faculty complex. They will be 44 weeks long; the object being to supply field staff for the RDAs. Extra teaching staff, one academic and three technicians, will be engaged. There is no mention of pastures and forage crops in the curriculum subject outlines (not shown here). The following is a breakdown of the major subject/time allocation.

TABLE 7 – SUMMARY OF CURRICULUM FOR CERTIFICATE IN AGRICULTURE (UBS)

Major Subject group	Total lecture periods	Percentage of course total
Crops	380	17
Animals	384	17
Land use and mechnization	612	28
Agr. Econ. and Extension	340	15
Basic	484	22

Evidently, the pasture crop will either receive minimal attention or be excluded entirely.

28. Adult and Youth Training Institutes

28.1 Farmers' Training Centres

There are at present three functional FTCs with a fourth planned at Big Bend in the Lowveld region but not yet started. The three existing Centres are :

(a) Lutheran FTC in the North of the country at Ngomini
(b) Nhlangano FTC in the Highveld region
(c) Veterinary Staff Training Centre at Mpisi in the Middleveld

These hold a variety of courses for adult men and women, usually of about one week's duration; providing a valuable supplement to field extension and opening an important channel of training in all aspects of agriculture and crop production.

Courses held at the Mpisi Veterinary Training Centre are of four basic types:

(a) Adult short courses in such subjects as :

Poultry
Artificial insemination
Dairying
Home economics

(b) Upgrading courses

A three-month course in Ranch Management was given in 1976 to train staff, mainly from the Veterinary Assistant cadre, for positions in ranch management. The syllabus was comprised mostly of practical work and some time was allocated to grassland management identification of plants, forage crops and fodder conservation. Similar three-month upgrading courses are held bi-annually, for about 15 staff members at a time, in various other subject groups according to requirements.

(c) One-year certificate courses

Intake; up to 20 at a time: the purpose being to train Veterinary Assistants. The curriculum for these is principally related to livestock, but pastures are referred to briefly in connection with rotational grazing; fires; and stock rates.

(d) Short in-service instructional courses for small groups of 10-20 staff members, for 2-5 days at a time.

28.2 4-S clubs

The 4-S movement to involve 'young farmers' between the ages of 9 and 21, is being actively encouraged by the Ministry amongst Primary and Secondary School children. The movement is still rather new in Swaziland, and so far only nine Clubs have been formed. A variety of subjects such as poultry keeping and horticulture is open for discussion. A problem is to find willing adult supervisors.

28.3 Farmers' Associations

These have been organized in a number of localities, and are in some respects a follow-on from the 4-S clubs, in which adult farming people and their wives may register. They are community based (not associated with schools) and meet weekly or fortnightly at convenient centres for community work and discussion related to agriculture and home economics. They are organized in the first place by Extension agents and are run by groups of entrusted farmers. Their principal aim is to foster cooperatives and many have already registered as cooperative societies. There may be several such cooperative movements within one RDA.

28.4 Gcina Youth Service

Attempts to deal with out-of-school training for young men with little or no formal education are centred on the Gcina Youth Service, which is similar in intent to the 'brigades' of Botswana. The training camp near Matsapha can take in 120 trainees annually, aged between about 17-23. They receive on-the-job training in basic skills; the main emphasis being on farming practice and theory, but with teaching also in other subjects such as building, farm mechanics and horticulture. The major purpose is to encourage the 'graduates' to return to their home areas where their knowledge can be put to practical use. The scheme is also open to girls.

As in Botswana and elsewhere, this level of training can provide the skilled foreman and artisan strata for which there is generally a place in rural communities. These institutions provide yet another of the many channels open for dissemination of progressive ideas.

29. Extension

The Extension services of the Ministry are strong and have available all the usual media for communication, which is relatively easy in such a small compact country. Apart from normal personal contacts, and the various institutional channels already mentioned, these include :

(a) Visual aids.

Slide sets, synchronized with various teaching topics, are being prepared by the Animal Husbandry division - to be used more especially for the training of in-service personnel. This work could later be extended to reach non-Government people.

(b) Film Unit.

A film unit operated by the Ministry from a Land Rover fitted with amplifier and projector spends about a month at a time in each of the four administrative districts It shows films at Schools during the day and in the countryside at night (slide sets could possibly also be used to good effect in this way). The films including a variety of agricultural topics, draw large audiences. They are foreign made, however, which probably detracts from the teaching relevance of some subjects. Senior Extension officers (one in each of the four districts) use these as 'crowd-drawers' for introducing other subjects.

(c) Press and radio.

Magazines produced include "The Rural Development News" (articles contributed by local people in a well-prepared small magazine); Field Support Memoranda; 'Opportunities in Swaziland's Agriculture'; Veterinary magazines and farmers' leaflets on specific crops.

There is a high rate of illiteracy, estimated to have been about 25 percent of the population in 1966. Therefore many cannot be reached by printed material but are open to radio and other media.

30. In-service training and up-grading

Already referred to in Section 28.1 and 29. The need for regular in-service training is well appreciated, and courses are held at the FTCs. Finding suitable teachers for the short courses and three month up-grading courses is sometimes a problem. When the Range Management course (28.1) was held, a large number of outside staff was reportedly called in to assist the different portions of teaching. Most of the candidates for up-grading have completed a one-year pre-service certificate course followed by 2-5 years' field experience.

31. Channels open to farmer/pastoralist participation in decision-making

The traditional way in which the people express their views to the authorities, in addition to personal approaches, is through the Tinkundla or district Chiefs' meetings.

Subjects of local importance are discussed at these meetings, at which the general public or their representatives may speak. For example, the setting up of RDAs has in each case been discussed at length in the Tinkundla and the wishes of the local people were expressed through the Chief to the Central Rural Development Board, which is the body appointed by the King in Council to deal with these matters. There is therefore, a traditional channel open between the people and their rulers, in addition to the other avenues of approach through the Government organization via the Ministry of Agriculture.

32. Summary of suggestions and impressions - Swaziland

(a) The country's pasturelands are sufficiently important to justify high-status representation by a separate unit within the Government Organization. Without such an authoritative coordinating body, the great pasture/forage potential is likely to remain largely neglected.

(b) A pre-requisite of pastureland improvement is security of tenure and enclosure of 'family farms' (25). This appears to be logical in sequel to current RDA land consolidatic leading to controlled unified use, with economic development based on the formation of cooperatives through the Farmers' Assoications.

(c) Comprehensive, annually revised personnel projections are essential for planned training programmes. Insofar as these may be lacking it is urged that estimates should be made as soon as possible.

(d) With one or two possible exceptions, the present curricula at all levels of training and extension appear very deficient in the grassland component: particularly serious in view of current livestock breeding programmes and the setting up of a dairy development project. There can be no improved livestock without improved nutrition, which must come principally from improved pastureland. The present natural plant communities are for the most part very poor and will not sustain highly productive animals.

(e) Substantial pasture improvement in the Highveld and Middleveld will entail:

correction of stocking rates;
correction of major plant nutrient deficiencies;
introduction of better grasses;
and especially, the introduction of effectively nodulating legumes.

(f) In the Lowveld, bush is a major problem.

(g) Existing buildings and facilities, together with those which are planned, appear sufficient for the country's training needs, as do the Extension Services which have good coverage through a number of channels.

(h) The lack of teachers in pastureland improvement and management is a major constraint coupled with insufficient top-level awareness of the great potential of this important resource, and the urgent need properly to manage and develop it.

V. TANZANIA - CURRENT PROGRAMMES

33. General information

33.1 National statistics

Total land area (mainland)		883 579 km^2
Approx. total area of pastureland		451 900 km^2
Approx. total area of commercial ranchland		2 520 km^2
Approx. percentage of grazing/browsing areas (which excludes national parks and most game reserves)		51%
National herd totals (1974):	cattle	12 098 000
	sheep	2 850 000
	goats	4 500 000
Estimated average growth rate of national herd		2.2%
Estimated average annual herd offtake		12 - 15%
Country total of human population (approx.)		15 000 000
Approx. proportion of human population engaged in agriculture		90%
Approx. average annual rate of population increase		3%

33.2 General information

The main development policy in Tanzania is directed towards establishment of the 'Ujamaa'village system under which scattered rural communities are being concentrated with the intention of cooperative development. Being a socialist state, large-scale private business enterprise is discouraged.

This has important implications in the field of training as agricultural advisory and supervisory personnel will be required in large numbers. The intention is to develop 'Ujamaa'farms and ranches using approved pastureland management techniques. The average standard of management remains poor, however, due to the continuation of traditional uncontrolled common use on many of the farms. The communal pasturelands, outside the present Ujamaa centres, generally show all the familiar signs of deterioration in the tse-tse fly-free areas, typified by degraded plant communities, sheet erosion, bush encroachment, and under-nourished animals especially in the areas of lower rainfall within reach of permanent water supplies.

The presence of the tse-tse fly, causing a high incidence of trypanosomiasis, is a major barrier to pastoral use over extensive areas, as is also the shortage of water. The potential for ranching is considerable however, and the current ranch development programme involves the staffing and building up of a large series of commercially-orientated ranches using World Bank Loan capital, and administered by a para-statal organization, the National Ranching Company (NARCO).

The training of ranch managers and assistant managers for these and other pasture-related projects is being undertaken at the Ministry of Agriculture Training Institute (MATI), Morogoro.

Many of the details of pastureland research, training and development activities, are available in a recent report (33).

33.3 Administrative organization

The Ministry of Agriculture contains four main divisions, each under a Director. These are :

Livestock Development
Crop development
Manpower development
Planning and marketing

The Director of Manpower Development is responsible for administration of training institutes at all levels, except for the University of Dar es Salaam, at which he is represented. The supervision and administration of a number of para-statal organizations including NARCO and the National Dairy Farming Company (DAFCO) come under a single coordinating body, the Livestock Development Authority (LIDA) which is related to but not within the Ministry structure.

There is no separate authoritative unit within the Government machine having responsibility for representing and coordinating all grazing land development including research, and the interests of this important resource are now divided between the Ministry of Agriculture units and the para-statal organizations. In consequence, it does not at present receive the attention it deserves, either in the Government or at the majority of training institutions.

33.4 Manpower requirements

No overall estimates are available for pasture-orientated staff of different grades in all sectors. There is undoubtedly a need for many more trained people of all grades both in the Government service and para-statal units, but financial stringency is very much a limiting factor.

A recent estimate of graduate requirements in pasture and range management (33), if these resources were to receive the attention they deserve, was put at :

	Required	Actual (1975)
Research	30	1
Training	20	2
Extension	25	5
Total	75	8

Such figures appear quite unattainable in relation to existing circumstances but they roughly indicate what the country could use theoretically in degree personnel alone; and the requirement of supporting staff would be correspondingly much higher.

34. Degree training

Degree courses leading to the Bachelor of Science (Agriculture) are offered at the University of Dar Es Salaam Faculty of Agriculture, Morogoro. The annual intake for this three year course is 70–80 students. During their third year, undergraduates have an option to major either in Crop Science or Animal Science.

The Crop Science Department gives a series of ten lectures and five practical periods (attended by all) in the second year, under the title 'Pasture Agronomy'.

Pasture Agronomy Course: University of Dar es Salaam

The course outline includes the following subjects: botany and identification of pasture grasses and legumes in Tanzania; grassland ecology; principles of grassland production; range and grassland management and improvement; sown grassland establishment, management productivity and utilization.

The Department of Animal Science provides a course of 20 lectures and 20 practical periods during the third year with the following title and details :

Range and Pasture Management and Utilization: University of Dar es Salaam

Utilization in relation to range management; importance of livestock numbers and season of grazing in range conservation; feed intake of grazing animals under various conditions; kind and breed of livestock for ranching; livestock management systems and range utilization; weed control in range management, and relation between wildlife and livestock in the use of range.

Within limits, lecturers may vary the subject content, and a moderate amount of teaching in pastureland management can therefore be given within the Animal Science stream. In fact however, both together are totally inadequate for the country's needs; the Crop science course providing only a bare introduction.

The Faculty can award M.Sc. and Ph.D. degrees, but no suitable facilities exist at present for pasture science studies. It is in any case argueable whether the present first degree course provides a satisfactory and sufficient foundation for advanced study. It is suggested that consideration should be given to setting up a separate Department of Pastureland Science, offering a third option in the first degree course during the third year, and leading from there to opportunities for advanced study at the M.Sc. and Ph.D. levels.

The establishment of a separate Department of Pasture Science would require additional equipment and facilities including laboratory space; seed and fertilizer stores; seed cleaning and testing equipment; drying ovens; mowers; and other items connected with research and the analysis of pasture samples as well as for field ecology studies.

Such a Department should also play an important role in helping to gather and collate the large amount of research information at present scattered within a number of centres and in the technical journals. This work would normally be done by a national grazing lands research organization, which unfortunately at present, does not exist.

There is already a lot of information in E. Africa which could, if put together and used, bring about a large improvement in pastureland productivity. It is doubtful whether lack of information is the main limiting factor - although certainly more research is needed. The current land use systems, socio-economic factors and customary attitudes towards pastureland are the more obvious factors which inhibit progress.

The Agricultural Faculty of Morogoro with its large area of farmland and proximity to developing ranches is well situated for pasture science studies at first degree and postgraduate levels. Consideration of this possibility is strongly recommended.

35. Diploma courses

One year in-service diploma training in which pastureland production is a relevant subject, is available at :

- the Ministry of Agriculture Training Institute (MATI), Morogoro.
- the Agricultural Research and Training Institute at Uyole near Mbeya.
- the Animal Health Training Institute at Mbwapwa.

Some pasture teaching is given during both the Uyole and Mpwapwa courses;and interesting investigational work with establishment of sown grass/legume (Desmodium) pastures has been carried out at Uyole.

The Morogoro MATI course - of which three have now been completed and a fourth is in progress - has an annual intake of about 30 students, many of whom have had previous experience in ranching and already hold certificates in Animal Husbandry or in Range Management from AHITI in Kenya. The main object is to teach ranching, with Pastoral Development as a secondary subject since most of the diplomates are required for work on the para-statal, District Council and other ranches.

The present curriculum, covering a period of 60 weeks, contains four separate syllabi, each having an equal time allocation. These are :

	Total periods
Range management	365
Animal Husbandry (and Health)	365
Ranch Economic Organization (Farm management)	366
Ranch Constructional Development	366

About half the time is spent on theory and half on practical work. The outlines for each syllabus, except Animal Husbandry, are shown as follows, together with the practical work suggested for each.

Animal Husbandry; details are omitted here because it follows already well-established lines in many other institutes, includes teaching in management of ranch livestock; breeding; feeding and health. Lectures on wildlife are also given within the same syllabus. Eight weeks of practical field training are included within the 60-week period; as well as public holidays, revision and examination time.

Curriculum for Ranch Management Diploma - MATI, Morogoro

I. **Range Management**

Periods Theory/Practical

Introduction : 15

The scope, objectives and national importance of range management
Some facts and figures concerning major pastureland resources in Tanzania
Relevant definitions
Points to note when visiting a ranch

Range ecology 35

The range ecosystem. Details of abiotic and biotic parts studied separately and in interaction; energy flow and nutrient cycles.
Plant ecology. Important factors which influence range plant communities; their development and classification both generally and in Tanzania

Traditional land use 10

Traditional land use. Examples from some important pastoral areas of Tanzania.
Seasonal movements of people and animals, causes and effects.
The problem of stock population and movement control in communal pastureland
Educational objectives and procedures arising from study of relevant traditional attitudes towards social organization (including female education and marriage dowry), land use, livestock, diet, money and consumer goods.
Desirability of shift from subsistence to cash economy.

Pasture plants 40

Applied botany; morphology and taxonomy of pasture plants.
Categories of pasture plants.
Cultivated forage plants
Common rangeland plants
Poisonous plants

Nutritional value of pastures 10

Dry matter measurement; variations in dry matter content of herbage
Protein; carbohydrate; fat; and vitamin content of pastures
Mineral content of pastures; mineral supplementation

Pasture establishment 10

Pasture seeds; grasses and legumes
Legume/Rhizobia symbiosis; legume inoculation
Establishment of cultivated pastures including possible use of fertilizers and manures.

	Periods Theory/Practical
Conservation and recovery of rangeland	20
Conservation of resources The cycle of destruction; the end results of continuous maximum pressure Recovery methods; reseeding possibilities Surface seeding (sod seeding) into established pastures for incorporation of improved grasses and legumes	
Proper use of range pastures; range condition; inventory of plant communities and forage	
Explanation of proper use, 'over-use' and 'under-use' Range condition and trend in condition; condition classes Forage inventory procedures, vegetation survey	
Stocking rates and stocking methods	20
Conventions, for calculating animal units (or stock units) Estimation of current stocking rate Estimation of forage yields, stock dry matter consumption and grazing capacity Average stocking rates for different classes of livestock in various environments; mixed stocking	
Basic procedures of pastureland management	25
Basic principles of management Explanation of non-specialized and specialized grazing systems Enclosure and sub-division of pastureland The control of herbaceous weeds and undesirable and coarse grasses	
Management of cultivated pastures	20
Grazing systems appropriate for planted farm pastures General management of cultivated forage crops Fertilizing and manuring	
Management of range pastureland	40
Grazing systems appropriate for ranches and communal rangeland Practical aspects of management, use of browse, effect of water distribution, herd control, theft, presence of wildlife Forestry in rangeland. Complementary and opposing objectives between ranch management and forestry Possibilities and procedures for tree planting on ranches Useful tree species	
Summary of pastureland management	10
Summary of techniques which are appropriate in various environments and differing land tenure systems	

	Periods Theory/Practical
Supplementary feeding	30
Kinds of supplementary feedstuffs and their uses on farms and ranches 'Standing hay' Cut hay making and storage Silage and silos	
Use of fire	10
Facts about fire The use of and misuse of fire in rangeland, fire control	
Bush control	30
The problem of bush in pastureland; its causes and effects Useful and obnoxious bush species. Bush control measures	
Important insect pests and possible control measures	10
Termites Harvester ants Army worm (Tse-tse fly and ticks are being treated as separate subjects within the animal husbandry section)	
Total	365

Practical skills - range management

Candidates should be competent in carrying out the following practical skills which receive special attention :

- Recognition and identification of both wild and cultivated pasture plants, with knowledge of their characteristics and potentialities. Common species within the following grass genera will be included, amongst others - Aristida; Cenchrus; Chloris; Cymbopogon; Brachiaria; Cynodon; Dactyloctenium; Digitaria; Eragrostis; Hyparrhenia; Setaria; Sorghum; Sporobolus; Themeda. Common species within the following legume genera will be included, amongst others - Cassia; Crotalaria; Desmodium; Dolichos; Glycine; Indigofera; Phaseolus ; Rhynchosia; Tephrosia; Vigna.

- Recognition and identification of common 'weed plants', with knowledge of possible control measures. The following herbs and grasses will be included, amongst others : Achyranthes aspera; Bidens pilosa; Commelina benghalensis; Cyperus rotundus; Digitaria scalarum; Eleusine africana; Galinsoga parviflora; Oxalis spp.; Ricinis communis; Rottboellia exaltata; Setaria pallide-fusca; Solanum spp.; Striga hermonthica; Tagetes minuta.

- Recognition and identification of bush and tree species, and their economic importance either as browse, shade, timber or undesirable plants. These will include various species within the following genera, amongst others - Acacia; Lantana; Balanites; Bauhinia; Boscia; Brachystegia; Cassia; Combretum; Commiphora; Croton; Dichrostachys; Euphorbia; Grewia; Julbernardia; Terminalia

- Collection, pressing, naming, labelling and storing of botanical specimens

- Identification and study of seeds, germination, purity and seed testing

- Taking soil samples and description of soil types

- Inoculation of legume seeds

- Description of range plant communities using standard conventions

- Forage inventory techniques, estimation of ground cover and species frequency and density. Estimation of bush density.

- Selection and marking of key sites for observations on range condition and trend in condition

- Recording procedures for range condition and trend in condition

- The planning of grazing systems and preparation of timetables for grazing systems.

- Recognition and use of meteorological recording instruments. Understanding meteorological data including various types of maps and charts. Measurement of forage dry matter yields.

- Recognition of fertilizers; manual distribution

- Hay making: cutting methods, curing, storing and visual assessment of quality

- Silage making

- Estimation of 'Animal Units'; stock rates and grazing capacity

- Ranch and farm visits; familiarity with important points that should be observed when managing or visiting a ranch. These include basic data on land area and estimation of distance and area, topography, rainfall, altitude, soils, plant communities, domestic and wild animals, water supplies and developments such as dips, spray races, buildings and equipment. Farm records scrutinized and important information extracted. Note that check lists should be used during field practical training on ranches.

Ranch economic organization

Ranch economic organization will encompass the meaning and importance of, and the scope and approach to, the economics of ranch organization . Stress will be given to the value of time; complete and accurate data and information as a basis for planning, organization, management and capital development.

	Periods
Ranch economies and records	
Agricultural economies	76
Introduction and overview Factors affecting ranch organization Climate and physical Social and economic Production and marketing Economic concepts affecting production and income Input-output relation Diminishing returns Cost and revenue Comparative advantage Profit maximization Production decisions	
Agricultural statistics and their use	40
Statistical concepts: means, averages, ratios Sampling: - frequency and normal distribution - random sampling Standard deviation Data collection: sources, methods, processing, tabulation presentation, interpretation Use of statistics: production and price indices, determination and projection of growth rates, methods of herd planning, productivity rates	
Organization of Agricultural Planning in Tanzania	40
Theory of planning Principles of planning Planning of new modes of production Effective use of labour and local resources Technical development of the productive forces	
Ranch Programme Planning and Organization	
Programme Planning	40
Definition of objectives and targets Physical area of operation, scope of programme Plan periods Labour laws Labour norms, quantity and quality of work Organization of meetings	
Preparation of Action Programme	60
List of main activities Physical requirements of each activity - manpower, job descriptions - materials	

	Period
Scheduling of activities - order in which activities will be carried out - estimated time of each activity - estimated time for entire project Schedule of transport requirements Financial schedule - Herd projection - budgeting, complete and partial - cash flow analysis	
Use of Network Analysis in Preparing Action Programme	30
Introduction of planning tools - bar chart - network	
Elements of a network - activities - events - event numbering - dummies	
Network construction - drawing the network - estimating activity duration	
Analyzing the network - event times - estimating project completion date - critical path - activity start and finish times and 'float' - milestone events, e.g. seasonal	
Drawing up the plan - using the network to draw up an action programme	
Control of implementation	30
Reviewing progress - inspection - assessing progress reports received from ranch staff - updating the network - recalculating of expected project completion data and critical path	
Preparation of progress report - activities completed - differences between programme and plan - reasons for delays - measures required for the rectification of delays	
Total	366

Periods

Practical skills - Ranch Economic Organization

Develop a livestock marketing schedule
Record livestock production data
Prepare a form for recording a tractor maintenance schedule
Record information and data of stores items
Prepare a depreciation schedule for a specified ranch machine
Develop proficiency in imprest accounting
Prepare a labour wages sheet
Prepare a job description for a new ranch staff position
Prepare a one-month programme of ranch activities
Develop a ranch transport schedule
Develop a beef herd projection
Prepare an estimated cost and return budget for a beef enterprise
Prepare a partial for marketing steers at 3 vs 4 years of age
Work up a cash flow for an Ujamaa Village beef project

Ranch Constructional Development

Introduction 10

Phases of development; practices and costs in a developing ranch

Stock handling control structures 30

Dip and spray construction and maintenance
Handling yards; crushes, design and construction
Night boma siting and construction

Fencing; gates and cattle grids 20

Types of fencing, their construction and maintenance
Gates and walk-throughs or stiles
Cattle grids

Ranch roads and firebreaks 20

Construction and maintenance of earth roads
Small bridge and culvert design
Making and maintenance of firebreaks and tse-tse fly breaks

Ranch building construction 50

Layout and design of buildings and structures to fit the environment needs. Concrete mixing materials and proportions for various uses. Making of concrete blocks, burnt bricks, and compressed earth/cement blocks. Cement mixing machines, and hand mixing. Woodwork, joining timber by bolts, nails, screwnails, and woodglue, cutting and planing timbers, making roof trusses, pillars, door frames, window frames, doors and shutters.

Metalwork, metal selection, metal strength requirements, shaping, drilling of holes, joining by screws, soldering, welding. Building construction and maintenance, an open-sided shed, an office or store, and a small living house.

	Periods Theory/Practical
Power machinery, and equipment operation and maintenance	76
Vehicles; operating principles, routine maintenance, servicing and major overhauls, using Land Rovers, trucks and tractor as examples	
Ranch water supplies; collection and conservation	60
Surface water; earth dams, tanks (chacos) and others Ground water; shallow and deep wells (boreholes) Water supply equipment for surface and deep well installation Centrifugal pumps Piston pumps Function of foot valves and gate valves Water reticulation Types of pipes, galvanized steel, polythylene, P.V.C., concrete pipes, lightweight steel and aluminium pipes. Pipe laying, joining techniques and fittings including valves and taps Storage tanks and drinking troughs: types of storage tanks, prefabricated bolt-together sections, corrugated sheet cylindrical tanks, circular reinforced concrete tanks. Drinking troughs; designs using concrete or steel. Operation of ballcocks.	
Ranch surveying and levelling	50
Useful data and calculations Maps and map reading: scales and conventions Survey and levelling equipment: chains, tapes, staff, compass, dumpy level Ground area survey: visual estimate, compass traverse. Use of dumpy level: levelling and contouring, setting out gradients for roads or water furrows	
Soil Conservation	25
General principles and methods of soil conservation Soil conservation equipment, use and maintenance Gully stabilization	
Irrigation : water spreading and water conservation	25
Irrigation Possibilities for use of irrigation in rangeland. Summary of crops commonly used, especially lucerne. Surface irrigation systems; characteristics; operation and maintenance Sprinkler irrigation systems; characteristics; operation and maintenance.	

Periods

Water spreading and conservation
General characteristics; aims, objectives and possible uses of water spreading. Design and function of ponding and wild flooding spreader systems, reservoirs, conveyance channels and dykes. Other water conservation practices, contour furrowing and ripping

Total 366

Practical Skills - Ranch constructional development

Most of this syllabus can be considered as 'practical' work, but special attention will be paid to the following aspects in which the trainees should be particularly proficient :

- Dismantling and re-assembly of other types of pumps, e.g. semi-rotary; vane and diaphragm.
  Changing of washers on valves and taps.
- The design and maintenance of drinking troughs and storage reservoirs
- Laying piplines and running repairs to pipelines
  Pipe threading. Texture of fittings to P.E. pipes
- Maintenance of dipping tanks and spray races, specification of spray race equipment from catalogue
- Construction details of crushes and collecting yards and their maintenance
- The siting and making of night bomas
- Erection of post and wire fences
- Road alignment, design and drainage
- Concrete mixing, methods used for making concrete blocks, laying floors, and building walls.
  Making concrete and earth blocks
- Familiarity with simple workshop tools and equipment for wood and metal work: operation of circular saw, planing machine, hand saws, hand planes, wood chisels and level. Sharpening fitting tools, sheet metal work, electric arc welding, oxyacetylene welding and cutting
- Maintenance of diesel and petrol engines. Simple fault findings and checking of an engine and its accessories
- Maintenance and adjustment of ploughs (mouldboard and disc), rotary cultivators; calibration of spreaders, sprayers and seeders.
- Measurement of electric current and voltage (using clip-on ammeter and multi-tester). Simple fault finding and testing of electrical equipment.
- Maintenance and simple repairs of a farm wiring system. Replacing a faulty cable, switch, fuse and resetting a circuit breaker
- Tractor ploughing, harrowing, seeding, and forage harvesting.
- Ranch surveying: use of prismatic compass, chains and tape, compass traverse survey; use of dumpy level; setting up the level, staff readings, setting out level contours and gradients for water furrows

Resident staff at MATI have consisted of a Principal and two lecturers: much assistance is also given by University lecturers.

It is considered that in time it will be desirable to broaden the subject base to bring in more teaching on pastoral development and grazing land management. The majority of the country's grazing areas - of vast extent - are under the traditional system of uncontrolled communal land use in the tse-tse free areas, and merit closer attention in training and development.

The stratification of pastureland training at the certificate and diploma levels also requires consideration. There is at present no certificate course available in this subject, and quite large numbers of people have been sent to the AHITI in Kenya for training. It appears desirable that Tanzania should develop its own institutional structures, more closely aligned with national policy and requirements, which could cater adequately for its great potentialities in the field of pastureland development and management.

36. Certificate courses

Several institutes, including those of Mwanza, Tengeru and Mpwapwa, offer certificate courses in Animal Husbandry and Agriculture, and it is recommended that a programme giving major emphasis to pastureland should be included where most convenient, at one of these.

Certificate training in this subject could then lead on to the MATI Morogoro diploma course , essentially for upgrading the best staff after a period of field service. The following comments on this subject, in the report already referred to (33) are agreed.

> " (Para. 5.341) Consideration should be given to providing training for a certificate course in Pasture Agronomy and Rangeland Management at Tengeru or some other location to ensure an adequate number of technicians and future candidates for advance training to Diploma or Degree level in Pasture Sciences".

37. Extension and in-service training

The 'Ujamaa' villagisation programme has created a need for extension workers known as 'Bwana shambas' at each place in future. These men will require a broadly based training - probably of certificate standard, and they should also be equipped with a sound working knowledge of pastureland management and the growing of annual forage crops.

It appears that the present cadre of extension personnel, who are administered by the 20 Regional Livestock Development Officers under the Regional Development Directors are for the most part lacking in the rather specialized knowledge necessary for pastureland development work because of the generally poor quality of teaching in this subject at training institutes.

Much could be done to make good this deficiency by calling in field teaching staff to attend short courses and discussion seminars for 1-2 weeks at a time at MATI Morogoro, or other centres. It is believed that there is an urgent need for extra training including instruction on species, establishment, and management of sown pastures and annual forage crops, irrigated lucerne and other sources of stock feed, and the principles of managing permanent pastures. Opportunities exist for in-service courses which are emphasized as being very important for extension workers in Tanzania - at the

different institutes during holiday periods and between set courses.

A major constraint, as also noted in Botswana and Swaziland is the scarcity of teachers who can give satisfactory instruction in this hitherto much neglected topic.

38. Summary of impressions and suggestions - Mainland Tanzania

(a) The lack of a sufficiently recognized and empowered unit within the Ministry of Agriculture to coordinate all ranch and pastoral development, research and training, is thought to be a major obstacle to progress.

The presence of such a unit need not disturb the present organization of ranch and dairy development by the para-statal companies, but could do much to supplement and coordinate programmes. Such an organisation, if adequately staffed, would ensure that the country's pastureland resources receive the top level recognition, financial support and qualified personnel needed for a more vigorous development programme.

(b) There is a need for degree training in the 'pasture sciences', taking in the whole ecological spectrum. It is suggested that an additional option should be opened to students in their third year of the course leading to the B.Sc. (Agr.) - provided by a new Range and Pasture Science department. This would provide a firm foundation for advanced M.Sc. and Ph.D. degree study.

(c) Consideration should be given to stratification of training in this topic in Tanzania. It is proposed that a Certificate (2-year) course should be provided at a convenient centre which could lead to upgrading at Diploma level for the best students after a period of 2-3 years of field service, as is done at present at MATI Morogoro.

(d) At present, the length of the MATI Morogoro Diploma upgrading course is thought to be about right provided that the annual student intake have all attended certificate courses previously, and have all had a period of field experience. The curriculum for this course could be broadened to include more pastoral development teaching.

(e) Much can be done to improve the standard of technical knowledge in this subject amongst field extension workers through short courses held for two weeks at a time.

(f) A major constraint to progress is the shortage of adequately trained people to teach Pastureland production at the various institutions.

It is therefore proposed that short courses should be started in the first place to update and augment the knowledge and training procedures of teaching staff.

(g) Accurate projections of 'pasture-orientated' manpower are very necessary in order to plan the country's training programme.

IV. INTERNATIONAL AND BILATERAL PROGRAMMES

39. Summary

Many organizations are contributing directly or indirectly to progress in different aspects of pastureland production. The valuable contribution being made by these bodies is referred to since some of their activities relate directly to training. In addition, information coming from their field experiences and projects, as well as from research results, provides teaching material and demonstration locations which can help to keep lecturing staff in touch with latest technical advances.

Examples of international organisations are :

World Bank; providing development finance on a very large scale in many countries
Food and Agriculture Organization of the UN (FAO)
United Nations Environment Programme (UNEP)
United Nations Education, Social and Cultural Organization (UNESCO)
United Nations Development Programme (UNDP)
International Livestock Centre for Africa (ILCA)
Integrated Project on Arid Lands (IPAL) by UNEP/UNESCO

Examples of bilateral programmes include :

United States Agency for International Development (USAID)
Overseas Development Ministry of the U.K. (ODM)
Swedish International Development Agency (SIDA)
Canadian International Development Agency (CIDA)

Many other countries also provide assistance in various fields of agriculture and pastoral development which, although not specifically mentioned here, can be a valuable source of information and help in training programmes.

39.1 The UN AGENCIES

Apart from the EMASAR programme, to which this report is addressed, and which is jointly sponsored by FAO and UNEP (2) (3), a number of UN activities are aimed at action to combat desertification and better management of arid and semi-arid lands. The UN Agencies have been, and are, involved in many education projects related to preservation of the environemnt and improved use of resources. The following quote from a 1976 review (5) summarizes the agreed UNEP strategy in this respect.

Environmental Education and Training (p. 91)

"The strategy put before the third session of the Governing Council contained the following elements :

(a) Training for officials, planners, decision-makers, specialists and other groups;

(b) Stimulation of education through institutions of excellence, regional programmes (seminars, symposia, etc.);

(c) Activities relating to the development of new curricula, teaching materials, information systems, etc.

(d) Development of instruments such as fellowships, institutional linkages, funding, and on an experimental basis, a Programme Activity Centre for environmental education and training"

Following the 1977 Conference on Desertification there was a "Workshop on implementation of a plan of action", lasting for five days. Subsequently, there are anticipated further seminars, described in the following terms (1).

"As the ultimate success of any anti-desertification campaign largely rests on the requisite number of specially trained personnel, it is proposed to organize more workshops/orientation courses at the regional level during the years ahead. Other efforts on education and training undertaken at the UN level will also be intensified and expanded as time passes"

Some relevant activities of the above organizations should be noted.

39.2 ILCA (International Livestock Centre for Africa)

Set up by a consultative group of international research organizations (about 15 nations contribute), its headquarters is at Addis Abeba, Ethiopia, with country programmes established in Kenya, Ethiopia and Mali; and projected but not yet started in Nigeria, Sudan and Botswana. In Botswana the monitoring of the World Bank-financed project on Tribal Grazing Land development will be one of the main activities.

Major interests include systems of animal production, advice and assistance with special problems, monitoring pastureland conditions, and in the longer term, some involvement in research.

ILCA also has an important function in promoting seminars, conferences and training programmes aimed particularly at three groups of people :

(a) the highest government officials responsible for planning programmes and development strategies, in short seminars;
(b) senior and administrative staff through workshops, conferences and training sessions;
(c) junior and intermediate staff categories by means of on-the-job training.

The seminar programme for the top level government officials will include such topics as : land reform practices and policies; water resource development strategies; sedentarisation of pastoral nomads; marketing of livestock and livestock products.

Sessions for the senior and administrative staff will be located mainly at Addis Abeba and will vary from possibly a few days to several weeks covering subjects such as experimental design; aerial monitoring techniques; and evaluation procedures for development projects.

The programme for junior and intermediate staff training will be principally for graduate personnel; teaching being within the framework of ILCA's research programme. Duration of courses will be from 1-3 years, but with shorter courses for specific purposes.

All work will be related to the urgent practical needs of African livestock development. Liaison is being established with a large number of universities and research institutes, not only in Africa but also in Europe, Australia and America.

39.3 IPAL (Integrated Project for Arid Lands)

Sponsored by UNESCO and UNEP, with UNESCO as the executing agency. Activities include both management and research; complementary to the EMASAR programme. Broadly speaking, it is applied ecology.

Work is proceeding at a number of centres starting in Kenya to be followed by Tunisia and Sudan; and other countries may also be included. In Kenya, the present work is based at Mt. Kulal (at Gatab) east of Lake Turkana; with staff and interests in the following disciplines :

- Forest Ecology (Acacia ecosystems)
- Wildlife Biology; studying the ecology of both wild and domestic animals - currently camels, sheep and goats;
- Grazing ecology, in which comparisons will be made between wild and domestic animals as a means of utilizing pastureland;
- Human ecology, in which the direct and indirect effects of people on arid land environments are being examined. Also, the efficiency of traditional nomad pastoralism, including human/livestock relationships, are being studied.

The IPAL projects will take about two graduate students in each of the countries in which they operate to work for 2-3 years on postgraduate assignments leading to advanced degrees from the students' own country universities. The number of postgraduates employed at any time is dictated by the ability of the project staff to supervise their work. Fellowships are attached to the project for this work. There is a possibility that IPAL may also be able to undertake some short courses within their fields of interest.

39.4 BILATERAL AID

USAID is active in assisting with development projects such as the organization of the large Grazing Blocks in the N.E. Region of Kenya. This organization also provides bursaries for advanced training in range management in the U.S.A.

Other bilateral programmes fulfill similar needs.

40. Comment

It is certain that much can and will be gained by those responsible for curriculum development, by keeping in close touch with these aid programmes and especially in regard to training subject-matter that is relevant to Africa, for which there is an urgent need.

Attention is therefore drawn to the work and reports emanating from the large World Bank, FAO, USAID and other development programmes either completed or in progress in the arid and semi-arid regions of Eastern and Southern Africa, which in themselves can provide a great deal of the textual material necessary for compiling training manuals.

VII. GENERAL IMPRESSIONS AND BASIC CONCEPTS

This brief survey of on-going development and training programmes in Kenya, Tanzania, Botswana and Swaziland has conveyed certain impressions and basic ideas which it is hoped will help to develop the regional and sub-regional strategy on information, education and training requested by the EMASAR programme. Some of the more important of these are mentioned below.

41. The time factor

As pointed out in Part 1, section 2, populations are doubling about every 30 years. Time is not unlimited for education to produce some necessary changes in customary attitudes towards land use. The major dilemma is that although people are conservative and slow to adopt new ideas, there is little time left before the presence of too many people in large areas of the pastoral regions, with the resultant over-burden of animals needed for their support, reduces the possibility of effective action. There is, therefore, an urgent need for large-scale training programmes in Africa now.

42. An 'African' pastureland philosophy

A new philosophy of training in pastureland production appears to be necessary for highlighting the particular needs and problems of Africa. It is recognized that the ideal solution - having local, well qualified and experienced technicians as teachers - is not to be reached in the near future and that some expertise will be required from abroad. This is to be accepted provided that assistance is used to develop the above philosophy.

Problems which are peculiar to this (Eastern and Southern) region are not encountered in some other Continents where training is generously offered - and education received outside Africa may therefore, often, be partly or largely irrelevant. An exception to this may be in some high altitude parts of Africa where climatic conditions may facilitate the transfer of technology from temperate to sub-tropical areas, although here again, socio-economic factors may well call for an original solution.

The need for building up 'Africa-based' and 'Africa-orientated' training programmes is therefore stressed. This has been evident to the writer for a long time, and was again very apparent during the mission tour.

To ensure that due emphasis is given to certain subjects, especially in the socio-economic field, some revision of the main curriculum title and sub-titles, with appropriate syllabus headings, has been tentatively suggested (Part I). Also a list of subject outlines which could be included in certain of the syllabi, is given in Annex 2.

It was noted that the term Range Management is not easily understood by pastoral peoples and many extension workers have definition difficulties. Pastureland Production is therefore preferred by this author as a title for the main subject. This can be conveniently sub-divided if required, especially for concentration on training in commercially orientated ranching. The division suggested conforms with the two major categories of land use discussed in Part 1.

The names used in this report for the two subdivisions are pastoral development and ranching. It is emphasized however, that divisions are only an expediency and that both pastoral development and ranching are parts of one and the same subject. It was also noted that overseas training, e.g. in the USA and Australia can be beneficial in those aspects which are less affected by the environmental differences, such as the scientific and ecological principles.

43. Level of university training

At Nairobi University, the opening of courses leading to first or higher degrees in Range Management, were under discussion, with some difference of opinion on whether the Range Management degree should be offered at first degree level or at postgraduate level with opportunities for M.Sc. and Ph.D. studies.

Taking a long term view of the country's requirements - and the fact that there is a demand, not only in Kenya but also in a number of neighbouring countries for graduate training, the arguments in favour of starting B.Sc. degree courses (Section 7) appear to outweigh other considerations. The hope has therefore been expressed that the University Authorities will decide to offer first degree training in this subject, with a sufficiently large commitment in extra staff and amenities to allow for an intake of candidates from other countries. The practical training facilities near Kiboko should then also be developed as quickly as possible.

Kenya appears very well placed for such a move, which will ensure that the future decision-makers will be men of the required academic status, equipped as far as possible with knowledge and experience acquired within the region. It is suggested that external capital could perhaps be attracted by the need for setting up expanded facilities, but that any such aid be made contingent upon the setting aside of a certain number of places for foreign students.

The same remarks apply to the University of Dar es Salaam, Morogoro Faculty of Agriculture, in which it has been suggested that a third year option to major in 'Range Management' should be offered through the opening of a new Department of Pasture Science.

As far as is known, no university in any African state in Southern or Eastern Africa, including Sudan, at present provides a B.Sc. course in this subject.

The University of Botswana and Swaziland, which offers a general degree in Agriculture, seems to be weak in the 'pasture' subjects; and appears unlikely to offer much scope at present for broadening its scale of activities.

44. International Grassland Production Institute

Much thought and discussion has centred upon the possibility of establishing an international institute perhaps serving some 20 countries within a region, at which young people of suitable school qualifications could go to read for first degrees and take higher degrees in the general subject of pastureland production or range management. This is mentioned here only to point out that the idea, whilst having some advantages, has been ruled out in favour of the more expedient development of the national universities wherever possible.

The political trend in Africa today, which is an overruling consideration, is towards greater national autonomy and self-sufficiency, and the natural preference will always be for building up these national institutions.

Other major considerations in favour of supporting and reinforcing the national universities as an accepted education strategy are :

- it will be less costly
- it will avoid conflict and overlap of interests between the international institute and the host country in which it is situated
- it will be easier; avoiding the staffing and other difficulties which would be sure to be encountered by an autonomous international institution acting independently within a host country.

It is therefore recommended that EMASAR should adopt a policy of full support for university training in Pastureland production and Range Management at first degree level through the existing national institutions; with encouragement to develop facilities for postgraduate training up to M.Sc. and Ph.D. standards.

45. Structure of training enterprise

Instruction in pastureland production should never, as a rule, be given in isolation, but as one of many factors in integrated resource development - usually closely coupled with teaching in Animal Husbandry and Health.

The following vehicles through which such teaching can be given are typical of the training structure in many countries, and are listed roughly in order of academic priority :

A. Formal school education :

(i) University (Ph.D
(M.Sc. or M.A.
(B.Sc. or B.A.

(ii) Secondary ('A' level
('O' level

(iii) Primary

B. Technical training (applied sciences including pasture science):

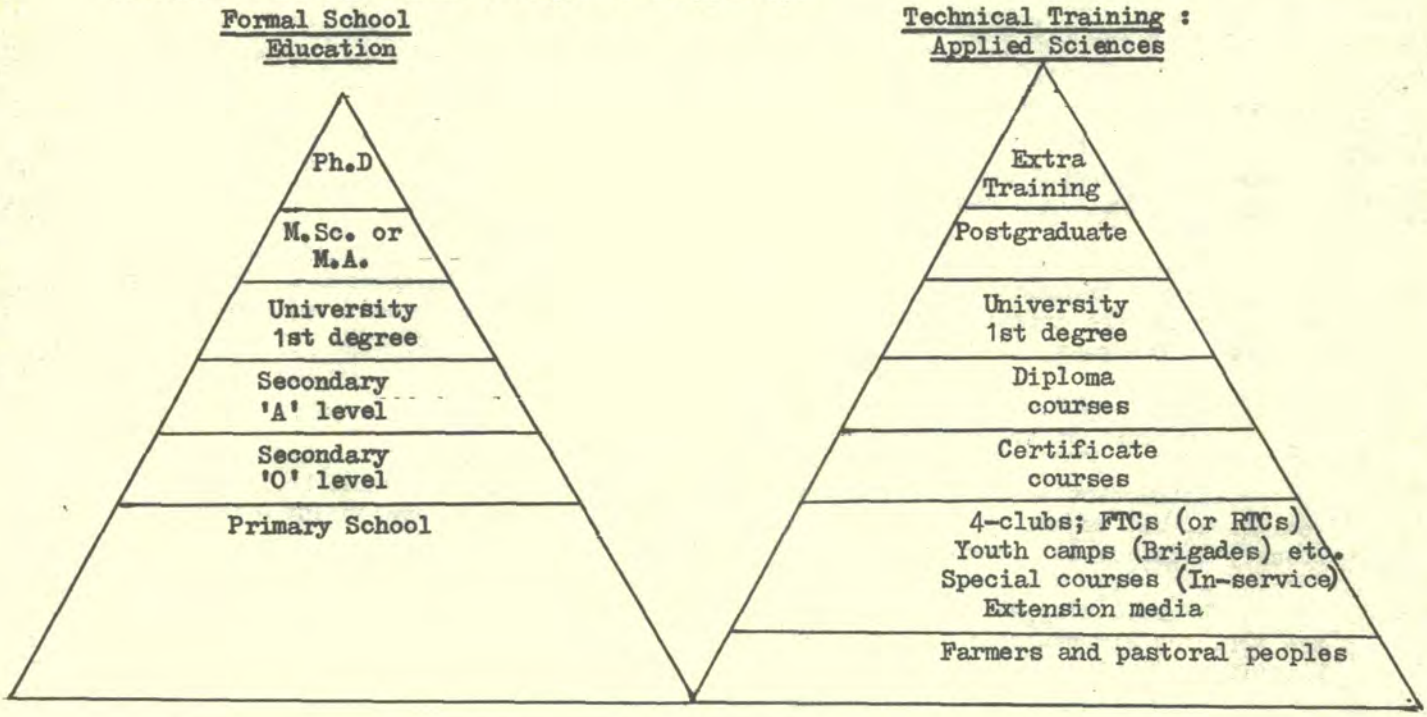
(i) University (Ph.D
(M.Sc.
(B.Sc.

(ii) Diploma

(iii) Certificate

(iv) Youth and adult education (4-Clubs
(Farmers' Training Centres
(Youth camps, e.g. 'Brigades'
(Special courses
(Extension media
- radio
- hand-outs
- mobile education or information units
- personal contact

Each of these requires attention and capital injection in order that it may play its full part in the education system. The different strata may, for convenience, be represented diagrammatically in the form of two 'pyramids' to draw attention to those particular strata in any country which may require strengthening and through which the national training endeavour might be stepped up.



The two 'pyramids' - the school system and the technical training system - are complementary to each other, and should be of approximately equal weight, since a deficiency in either will affect the other, impeding the flow of trained manpower.

Of course, not all the different levels in both these pyramids are equally open to instruction in pastureland production, but there are no doubt many opportunities for bringing it into the teaching, which are now being missed, and which could do much to impress young people with its great national importance.

It is suggested that, as a matter of general policy, there is no need for a full three tier training system from Certficate through to Degree standard in any of the developing countries in this region at present. Instead, if and when all three levels exist, it is proposed that all trainees in pastureland production should enter at the Certificate stage, and that only the best of these should continue to the Diploma level, which could then be regarded solely as an upgrading course - after a satisfactory period of field work (Section 9.2). In that event, the diploma upgrading course need only be for about one year rather than three. Where there is no adequate university course in this subject, then the full three-year Diploma training appears justified, as it partially fills the need for degree training. In any case students who attend Diploma upgrading courses after successful completion of the Certificate, should be credited with reduced time in the new course to avoid re-sitting for the whole period.

46. Technical literature

A major constraint to progress not mentioned hitherto is the present widespread need for Africa-orientated textbooks. Whilst books and manuals on Animal Husbandry and Animal Health are generally well represented in institutional libraries the same cannot be said for literature that has a bearing on pasture plants and pasture/animal production. The need for more literature of this type has been well recognized for many years but so far the amount being produced is far from sufficient to meet the requirements. The reason is not that there is still too little known. On the contrary, a great deal of technical work has been completed in many different parts of this region and on many different aspects, from vegetation survey, to wildlife studies, to socio-economic studies, census and planning, and other activities related to pastoral development and ranching.

One reason for the paucity of textual material is that the experts who have carried out much of the work in many fields have generally been aiming at completing a specific mission or task related to development projects, with no thought in mind for the possible adaptation of the work for teaching purposes. Since there are numerous reports available in the libraries of FAO and other international bodies and in the national archives of many countries, the following strategy is suggested :

(a) The urgent need to make available a much larger quantity of technical teaching material for use in African institutions should be recognized;

(b) For this purpose, a three-man 'Author-project' should be set up with the two fold object of :

(i) collecting existing material into 'manual form' - with necessary deletions, additions and 'streamlining' to make it more useable for medium-level education;

(ii) writing, in a new and acceptable form, those sections of the subject which are not at present well covered by existing reports or other literature.

(c) It is suggested that this Author-project should be appointed by one of the UN agencies - say FAO - on a two-year contract to start with, and based at a convenient centre, either in Africa or in Rome. Situation of the Headquarters at Rome would have the advantage of easy access to the library where there is much useful material.

(d) Money should be available for travelling to see conditions at first hand and to collect information, and also to invite additional contributions from other experts in various fields according to needs and opportunities.

(e) The teaching material would be produced in the form of a series of loose-leaf folders in major subject sections; each set of notes being as relevant as possible to the particular country where required. Thus, whereas many of the sections would be similar for say both Uganda and Botswana, others describing important physical or climatic features, or different socio-economic, or botanical aspects, would be different and should therefore be varied to suit particular countries. There are some good examples of loose leaf manuals available in the literary world which could perhaps be used as models.

(f) It is visualized that the Author-project would continue almost indefinitely because of the need for constant updating of information, and incorporation of new research finding and procedures as these become available.

(g) The major subject divisions, suggested in Part I in the curriculum outline, might be appropriate as some of the subject headings for loose-leaf binders. These are :

Botany (Taxonomy)
Ecology
Pastureland production
Wildlife
Animal Husbandry
Animal Health
Pastoral Development Planning and Administration
Constructional development (including water)
Rural Economy
Social organization
Business management
Teaching and Extension: visual aids
Research

Each of these could of course be sub-divided later if necessary, for example; Water Supplies could come under a separate heading.

It is suggested that the three members of the team should initially be :

- a 'Plant' man (having an agronomy background)
- an ' Animal' man (having a stock background)
- a 'Socio-Economist' (having a social background)

If this idea is agreed in principle, it may be advisable to appoint an exploratory mission to look further into the situation, details, functions and cost.

47. Grassland production teachers

Pastureland production is a synthetic subject, made up from a number of other subjects; the proportion of the ingredients varying according to local circumstances, length of course, specific requirements, teacher capability, and other factors. Therefore, especially at small institutes where teaching staff are few, versatility and breadth of practical knowledge are important qualities. Because of its rather diverse nature - encompassing social and economic problems as well as the applied pasture sciences, it will probably never be possible to produce a series of books that can satisfy all teaching needs in every situation; and in the final analysis the success or failure of a course will depend quite largely on the ability of the teacher himself to identify the important local needs, and to lay stress where it is most required.

There are however, many basic concepts of pastureland production: stocking rates, grazing systems, plant species, condition and trend, bush control, conservation, and many others which can be learned and which provide a necessary foundation for the build-up of later experience. It is in these aspects that there exists an urgent need for more well-qualified teachers in all the countries visited, with the possible exception of Kenya.

Alternatives for meeting this need are :

(a) to send staff - of diplomate or degree level - abroad for training, from where they would return to take up teaching appointments in their own country: not ideal for reasons given in Section 4, but may be resorted to for bridging initial gaps, provided fellowships are used for specialized technical training.

(b) to bring expatriate experts to Africa to help in setting up a series of teacher-training courses. This has the weakness that expatriates should as a rule spend up to about a year after first arrival familiarizing themselves with the local environment and problems before starting to teach. It would be unwise, especially if teacher training is the object, to expect newly-arriving foreigners to engage in such work before having enough time to appreciate and study the special problems of the communal grazing lands.

(c) to train African diplomates and graduates themselves - in teacher training courses - to enter the teaching profession.

As a general policy this third alternative appears much the best and it is therefore urged that Grassland Production teacher-training should become a top priority task immediately wherever there is a need - although no doubt all three approaches will continue to be used. Help from some of the Agencies mentioned in Part VI can no doubt also do much to fill this important gap. It is again emphasized that what is needed are qualified teachers at all levels, especially down to the FTC standard, so that extension workers, youth group teachers and those who are in direct contact with the public may be encouraged to take greater interest in this absorbing subject, and may be better able to face some of its daunting problems.

48. The building up of national technical training structures

The following quotation from the EMASAR report (2) Section 2, is referred to once again :

> "So far as possible, training should be based on existing facilities. It takes time and money to build new institutes"

In the light of current experience, this appears to be a cardinal principle; and the author would like to endorse the need for EMASAR to work through , reinforce, and help to expand the existing national institutions, rather than suggesting sweeping changes unless these are absolutely necessary. An example of where the existing arrangements appear inadequate is in Kenya where the present number of FTCs are insufficient for the country's needs and where the 'slide set' library could probably be used more effectively if expanded and updated.

49. Miscellaneous notes

A number of other concepts which may be secondary, but important, have also arisen from consideration of current work, and from discussion with the many people met during the tour. These are :

49.1 Any course - whatever its purpose - should always be terminated by an examination. The knowledge that there will be an examination at the end acts as a useful stimulant. Exams can also provide a useful guide to a man's aptitude for a particular type of work .

49.2 An evaluation of training - such as through questionnaires sent to the participants or their officers after a period of field work, gives an invaluable guide to teachers concerning the relevance of their course subject matter and the quality of their teaching.

49.3 A frequently-heard comment from field staff is that training curricula are insufficiently orientated to job descriptions. This is a point of great importance; and a subject which should be discussed at periodic seminars between field and teaching staff.

49.4 Foreign loan capital provided for improving training facilities, should generally always include an adequate foreign exchange component for the purchase of books. The cost of these is often prohibitive and many institute libraries are very poor.

49.5 There is quite a wealth of valuable technical literature on various aspects of grassland production in the different countries of the sub-region concerned, as well as with international and bi-lateral institutions. This should be utilized for the preparation of appropriate handbooks and manuals".

50. Liaison between international agencies

Lack of liaison between international and bilateral organizations having varied but related interests in pastureland production, is believed sometimes to reduce the overall efficiency and effectiveness of efforts towards integrated resource development, management and conservation.

The reasons for this are not all clear, but could include

- oversight;
- unwillingness to divulge ongoing plans, some of which involve large-scale expenditure;
- lack of appreciation of the value of liaison and cooperation

Whatever the cause, a plea is made here for greater liaison between international groups which have an interest in pastureland development: before, during and after the completion of projects. It is recognized however, that responsibility for liaison rests with the recipient countries.

Widespread notification of ongoing plans and projects between international bodies has a number of advantages :

- avoidance of wasteful duplication and overlap;
- mutual assistance: it is often possible for personnel in one unit or group to help people in another, where the two may have been engaged in similar areas of study;
- mutual stimulation of ideas leading to more thorough analysis of problem situations and their solutions; and above all,
- the value of making concerted attacks on common problems.

While most would probably agree on the desirability of greater liaison, it is not certain how this could be achieved; but two possibilities have been suggested. These are :

- the issue of bi-annual broadsheets by each of the agencies, summarizing completed projects - with report references; current projects; and agreed future projects, in various fields of work;

These to be circulated as widely as possible to anyone within and without the present organization who may be interested, with the knowledge and agreement of the recipient countries.

- an annual seminar, held at say, FAO in Rome, or at a key location in the region, to discuss and review ongoing work in grassland production, and to give people from different organizations such as UNEP, UNESCO, UNDP, FAO, IBRD and ILCA, an opportunity of meeting and exchanging notes and information.

Such seminars should, it is thought, consist of brief descriptions and discussion by individuals of progress to date and need not involve the participants in preparation of lengthy scientific papers. The results need be recorded only in a series of minutes.

The discussions could fall into the three categories :

training and extension;

research;

development.

ACKNOWLEDGEMENT

The Author would like to record his sincere appreciation for the help, willing cooperation and kindness shown by all concerned without exception, throughout the time of the mission, and especially while on tour in Kenya, Botswana and Swaziland.

The kind assistance of colleagues at F.A.O. is also gratefully acknowledged. In this regard the Author is particularly indebted to Mr S.A. Risopoulos and Dr C. Poulton for advice and time spent on editing the draft.

ANNEX 1

SUMMARY OF ITINERARY

Starting from Rome :

Arrival date	Place	Departure
9.1.1977	Nairobi, Kenya	15.1.77
16.1.1977	Gaborone, Botswana	20.1.77
21.1.1977	Mbabane, Swaziland	28.1.77
29.1.1977	Nairobi, Kenya	3.2.77

ANNEX 2

SYLLABUS SUBJECT MATTER

A total of 11 separate syllabi have been suggested (Part I, Section 4) as convenient for making up a complete and comprehensive training programme for a pastureland production course. Although some of these could no doubt be combined and different names applied, the subject matter has been divided up for presentation in this way to try and ensure that proper weight is given to each aspect, especially in the socio-economic subjects.

Outline summaries for only four of these syallbi are suggested here; the others being either quite well known and well established in existing curricula, or with examples already given in the main body of the report.

The suggested 11 syllabi which could comprise a complete curriculum (but not necessarily all used in one course) are :

*Ecology
Grassland production - see example Part V, Section 35
Animal Husbandry and Animal Health (Divided into two separate syllabi if necessary)
Wildlife
*Pastoral development Planning and Administration
*Social Organization
*Rural Economy
Teaching and Extension Methods (Visual aids)
Constructional development
Business Management
Grassland Research (mainly only for degree courses or special training programmes

The four which are outlined in this annex (*) are probably not complete and no doubt more detailed study within each will reveal additional items that could and should be included to cater for local circumstances. It is hoped however that they may serve to indicate the general lines along which these particular syllabi might be developed, especially to open the way for in-depth study of the important socio-economic aspects.

2.1 Ecology

The arrangement suggested here, in three sections, has been found convenient for training at diploma or certificate levels where much of the necessary basic science teaching can, to good advantage, be associated with ecology. There is sometimes a tendency to waste time in the early stages by going into too much detail in separate subjects such as soil science, botany and general ecology, leaving too little time for the more applied teaching. The combination suggested here has proved useful in helping to keep the basic science subjects in perspective with the rest of the curriculum and, more important, to impress students with their relevance as an integral part of pastureland production.

SEC. I GENERAL ECOLOGY

Introduction

Meaning and scope. Reasons for studying ecology; its application to agricultural and pastoral environments - interactions between living things and their surroundings. Man a part of, not separate from, biological systems; human ecology therefore an essential and proper subject for study.

Different branches of the science of ecology explained and discussed. Organization within the biological kingdoms. Taxonomic and other groupings.

Definition of common terms.

Populations

Population attributes, or values; both quantitative and qualitative.
Methods used for collecting data; sampling and sampling units
Patterns of population change (dynamics) in people, animals and plants

Controlling factors.

Causes of differentiation between organisms

Communities

Adaptation of organisms to environment;structural,physiological and behavioural. Relationships between organisms; parasitism, mutualism, predation and others. Interchange of energy within communities; the food web; food chanins. Trophic structure. Energy flow.

Ecosystems (or Biological systems)

The typical parts of an ecosystem: abiotic and biotic

Cycling of substances within ecosystems, e.g. hydrological cycle; nitrogen cycle and others.
Important relationships within ecosystems
Farm and pastureland as biological systems having typical components

SEC. II. PLANT ECOLOGY

Explanation and scope

Major interests of plant ecology. Natural, semi-natural and cultivated plant communities.

Autecology and Synecology
Definitions and common terms

Plant growth in relation to environment

Life forms and adaptation to environment : structural characteristics of hydrophytes; mesophytes and xerophytes.
Factors affecting photosynthesis and storage of root energy reserves: drought, age; use.
Plant growth and climatic cycles; seasonality. Recovery patterns of grasses and bush after use.

Different types of root systems in pasture plants. Factors affecting size of root systems.

Fire-resistant mechanisms in plants
Seed dispersal, and regeneration of plants in permanent pastureland.

The development of plant communities

The process of development of plant communities: migration, establishment and succession leading to equilibrium.

Plant succession and ecological succession, with associated terms and ideas such as seral; sub-climax; and climax communities.
Autogenic and allogenic succession.
Retrogression defined.

The structure of plant communities

Explanation; plant communities have recognizeable form and structure. Dominant and sub-dominant species.
"Horizontal structure" - changes which occur across country. Commonly-used classifications for different units of vegetation: formations; associations; societies and others.

"Vertical structure" of plant communities; stratification; layer societies.

Physiognomic classification of plant communities

Description and examples of grassland; bushland; woodland; forest; and other categories.

Ecological zones

Explanation and examples of ecological zones, ecotones and ecological classification The practical usefulness of ecological classification in agricultural and pastoral developmer
Ecological maps.

SEC. III GRASSLAND ECOLOGY

General view

The different environments of rural Africa from moist 'agricultural zones' to semi-arid or arid 'pastoral zones' described and illustrated.

The influence of different land tenure systems on management and development of pastureland.
Summary of important renewable and non-renewable resources; their inter-dependence within the biological system.

Major features of pastoral and agricultural societies: sedentary and migrant communities of people and animals. Causes and effects of movement.
Effects of environment on land use.

Climate and weather

Important influences on pastureland described. Climatic factors detailed: precipitation; temperature; humidity; radiation; light; wind; evaporation.

Meteorological instruments and their use.
Meteorological records; maps and charts
Climatic cycles; their causes and effects on the ecology of pastureland
Drought; frequency and effects.

Human influences

Human dominance and responsibility.
Direct and indirect effects of people on pastoral ecosystems; cultivation; clearing; burning; stock raising and others.

Population dynamics; family size; population growth rate.

Food requirements and sources of food related to stock numbers and land area.
Customs and attitudes which either directly or indirectly affect pastureland, especially traditions related to livestock numbers, uses and movements.

Biotic (other than human) factors

Important interactions between plants and grazing/browsing animals.
Wildlife effects on pasture/animal production
Other biotic factors such as insects.

Soil (edaphic) factors

Soil formation; profiles and stratification
Soil properties; composition, mineral, organic and biotic content, fertility and productivity.
Texture
Structure
Colloids
Air and water content, 'drainage', water retention by soils; soil/water relationships and measurement of soil moisture.
Soil colour. Use of colour charts
Classification of soils
Sampling methods
Catenas and catena effects

Important ecological relationships between soils, pastures, animals and people.

Physiographic factors

Influences of land slope, aspect, elevation and other physical features on plant growth and pasture management and development

Fire

Fire as a major factor in the development of ecological communities of plants, animals andpeople.
Possible beneficial and harmful effects of burning.

Water distribution and development

Effects of introducing permanent water into arid and semi-arid areas. Interactions between water development; animals; plants; soils and people.

Importance of an ecologically integrated approach to water development in national planning.

Retrogression

The apparent extent and degree of grassland deterioration within national and regional areas. Direct and indirect causes of deterioration identified with possible consequences assessed. Indications and stages of retrogression observable in the major ecosystem components.

The variable end-point of maximum human/livestock pressure on pastureland observed in different environments; shifting sands; stone mantle; dense scrub; and others.
Possible ecological solutions summarized; to be expanded in later teaching.

2.2 PASTORAL DEVELOPMENT PLANNING AND ADMINISTRATION

1. Customary land use amongst the major national groups of people. Land tenure systems.

2. Possible advantage and disadvantage of current land use

3. The Government policies in regard to land use changes and reforms

4. Aim of planning, to introduce ecologically more stable systems by attempting to relate stock ownerships to responsibility for the pastureland :

   uncontrolled communal use
   transitional forms
   controlled unified use

5. Examples of development planning

   5.1 Earlier 'grazing schemes' and other efforts at improvement. Results: reasons for failure

   5.2 Present development schemes: within the country. Examples of ongoing schemes in other countries which could be applicable.
   Pastoral development possibilities; group ranches; 'grazing blocks'; co-operatives, ranching companies, and others

6. Pre-development survey and census:

   People
   Livestock; herd structure, yields, offtake and other data
   Vegetation; condition and trend
   Soils
   Water supplies
   Communications
   Areas of authority
   Seasonal movements
   Wildlife
   Collection, processing and use of data

7. Aerial photography - combined land survey. Aerial photograph interpretation. Survey and delineation of development units

8. Setting up and administration of pastoral development projects - taking one or two examples and studying these in depth.

   Public relations
   Capital availability
   Administrative organization
   Loan repayment
   Marketing and stock-offtake
   Management systems
   The problem of stocking rate control
   Major difficulties encountered : maintenance of fencing and water supplies; social problems.

2.3 SOCIAL ORGANIZATION

1. The major ethnic groups; history and characteristics

2. Land areas occupied; statistics; numbers of people. Populations and population growth rates related to land area, and stock numbers needed for their support

3. The problem of stock dependent peoples exceeding the support capacity of their land: inflexibility caused by too many people. The present situation in this regard in various parts of the country.

4. Social units within the major pastoral groups of people. Traditional authority organization, starting from largest groupings through to clans, sub-clans and families. Degree of cohesion within tribal groups; age classes

5. The place of women within the social structure

6. Stock ownership and distribution. Importance and use of livestock within the social system: ceremonies; marriage dowries; contracts and other transactions involving livestock. The relative importance of different kinds of animals: cattle, sheep, goats and camels.

7. Traditional attitudes to agriculture; food and dietary customs; money and consumer goods; education; health

8. Marriage; family size. Family limitation

9. Decision making powers; traditional meeting procedures. The right to speak: social classes within the community. Ultimate authority for concluding agreements or reaching decisions which affect the community.

2.4 RURAL ECONOMY

1. Rural development. Requirements and costs: communications; market centres; water supplies; administration. How does development occur? Government procedures

2. Sources of capital; possibilities for borrowing and repayment, Government revenues, direct and indirect taxation.

3. Value of national herd; percentage offtake; losses from famine. Possibilities for stratification of livestock industry.

4. Traditional marketing system: from the herdsman through middlemen to consumer. Prices received, market fluctuations, causes of loss. Modern marketing methods, stock routes, holding grounds; quarantine.

5. Major needs of rural communities; water supplies. Improved marketing structure for more rapid offtake; better communications.

6. Average per capita income and sources of income. Average annual expenditure. Requirements of consumer goods by pastoral people. Quantities, type and value of food consumed.

7. Encouragements towards greater use of money; banking facilities- mobile banks.

8. Education amongst pastoral peoples. Methods: school centre; mobile units. Cost and payment for education. The teaching of girls.

9. Possible alternative forms of employment

10. The possible future of pastoral areas if present trends of growth in population and customary land use are continued.

11. Reasons for nomadism and transhumance. The effects of sedentarisation of traditionally nomadic peoples.

ANNEX 3

REFERENCES AND BIBLIOGRAPHY

3.1 INTERNATIONAL REFERENCES

1. (1976) "International cooperation to combat desertification: workshop on implementation of plan of action". UNEP Secretariat of UN Conference on Desertification, 21.12.76

2. (1974) "The ecological management of arid and semi-arid rangelands in Africa and the Near East". Report of an expert consultation. FAO. AGPC:MISC/26

3. (1975) "The ecological management of arid and semi-arid rangelands in Africa, the Near and Middle East (EMASAR)". Report of Conference 3-8 February 1975 AGPC:MISC/31, FAO, Rome.

4. (1975) FAO SIDA "Training Course on Tropical pasture science and Range management for East Africa". FAO/SIDA RAF/88/SWE.

5. (1976) United Nations Environment Programme: review of the status of the programme Report of Executive Director to Governing Council. UNEP GC/61, Nairobi, Kenya

3.2 KENYA REFERENCES

6. BISHOP, D.R. & LEWIS, R.W.E. (1971) 'Range Education'. Report of Range Management Division of Ministry of Agriculture, Kenya. AGP SF/KEN 11. Technical Report 2

7. (1976) Egerton College Academic Programmes and 1976 catalogue

8. PRATT, D.J. et al. (1975) "Range Research in Kenya; a technical and organizational plan for future range research in Kenya". Ministry of Overseas Development Appraisal Project PROP 18/75

9. SIMPSON, M.C. (1973) "Alternative strategies for rangeland development in Kenya" University of Leeds: School of Economics. Rural Development Study No 2

3.3 BOTSWANA REFERENCES

10. AGRICULTURAL SURVEY 1970/71. Government Printer. Gaborone, December 1971 .

11. ANIMAL PRODUCTION RESEARCH UNIT (1973) "Beef cattle and range research programme in Botswana 1970-1973". Ministry of Agriculture, Gaborone

12. ANIMAL PRODUCTION RESEARCH UNIT (1975) "A five year programme of integrated beef cattle and range research in Botswana 1970-1975". Ministry of Agriculture, Gaborone, Botswana

13. ANIMAL PRODUCTION RESEARCH UNIT (1976) "An integrated programme of beef cattle and range research in Botswana 1970-1976" Ministry of Agriculture, Gaborone, Botswana

14. CHAMBERS, R. & FELDMAN, D. (1972) "Report on rural development". Ministry of Finance and Development Planning, August 1972.

15. CHILD, G. (1972) "Development of the wildlife industry". FAO No. TA 3083

16. KUKLER, R. 1976. "Follow up study of graduates from Brigade Centres". Ministry of Education. Government Printer, Gaborone

17. LEVER, B.G. (1970) "Agricultural extension in Botswana". University of Reading, Department of Agricultural Economics, Development Study No. 7, Gaborone, July 1970.

18. SIMPSON, I.G. (1969) "Surveys and training for the development of water resources and agricultural production, Botswana" FAO. EA:SF/BOT/1 21 May, 1969

19. (1976) "An application by the Government of Botswana for a loan to finance a second livestock development project". Division of Planning and Statistics. Government Printer, Gaborone

20. (1976) "Botswana Agricultural College Handbook" Private Bag 0027, Gaborone

21. (1976) "Botswana's Brigades". Government Printer, Gaborone

22. (1971) "Proceedings of the conference on sustained production from semi-arid areas". Botswana notes and records. Special edition No. 1 Government Printer, Gaborone

23. (1975) "Report on the agricultural marketing seminar from Botswana, Lesotho and Swaziland". FAO. AG:DP/BOT/71/012. Seminar Report 1.

24. (1972) "Rural development in Botswana. Republic of Botswana, Government paper No. 2, 1972.

3.4 SWAZILAND REFERENCES

25. MAINA, M.N. (1976) "Land tenure, Part III: The most productive systems" Swaziland's Rural Development News, Vol. II, 4. August 1976

26. MURDOCH, G. "Soils and Land Capability in Swaziland

27. PHORORO, D.R., BEMBRIDGE, T.J. & DENT, G.C. (1976) Improved strategy for animal production. Roneoed report.

28. PRESSWOOD, J. (1976) "Proceedings of a seminar on grass productivity", 'Sisa' ranches, and Group ranches. Ministry of Agriculture, Mbabane.

29. Ministry of Agriculture, Mbabane: 4-S Youth Section. Roneoed report

30. 'Second National Development Plan 1973-1977'. Swaziland Printing and Publishing Co., Mbabane, Swaziland

31. 'University College of Swaziland Calendar, 1976-1977'

3.5 TANZANIA REFERENCES

32. BERRY, L. "Tanzania in maps". University of London Press

33. EDYE, L.A. & BOUDET, G.G. (1975) "Report to the Government of Tanzania on expansion of pasture and rangeland activities in Tanzania", FAO, Rome ref. DP/URT/72/027 of October 1975.

3.6 SOME USEFUL TEACHING REFERENCES

34. ALLRED, B.W. (1968) "Range management training handbook for Saudi Arabia", FAO, Rome.

35. ALMA CHESNUT MOORE. "The grasses". MacMillan and Co., New York.

36. BENTLEY, J.R. "Bush control in Kenya". Agency for International Development, Nairobi, Kenya.

37. BISHOP, D. & BUTTERWORTH, M. (1975) "Bush control" Extension/Training Office of Ministry of Agriculture, P.O. Box 126, Mbabane

38. BOGDAN, A.V. "A revised list of Kenya grasses". Government Printer, Nairobi

39. BOGDAN, A.V. & PRATT, D.J. (1967) "Re-seeding denuded pastoral land in Kenya" Government Printer, Nairobi

40. BOGDAN & STORRAR (1954) "The control of Aristida and other annuals in Kenya Rift Valley pastures". Empire Journal of Experimental Agriculture, Vol 22 No.87 Reprints from Clarendon Press, Oxford

41. BOONMAN, J.G. (1973) "On the seed production of tropical grasses in Kenya" Pudoc, Wageningen, 1973

42. BROWN, L.H. (1971) "The biology of pastoral man as a factor in conservation". Biol. Cons. 3, 93-100.

43. CHIPPENDALL, K.A. & SCOTT, J.D. "The grasses of South Africa". Cape Times, Parow, S. Afr.

44. CHIPPENDALL, K.A. & CROOK, A.O. "Grasses of Southern Africa". M.O. Collins, Salisbury

45. DALE & GREENWAY. "Kenya trees and shrubs". Hatchards, London

46. DAVIES, W. & SKIDMORE, C.L. "Tropical pastures". Faber and Faber

47. DAUBENMIRE, R.F. "Plants and environment". John Wiley & Sons, Inc.

48. DIXON, M.G. (1966) "The development of the pastoral areas of Kenya". Paper prepared for the 1966 Summer Conference in Tel Aviv, Israel. Massachusetts Institute of Technology

49. EVERIST, S.L. (1969) "Use of fodder trees and shrubs" Queensland Department of Primary Industries, Division of Plant Industry; Advisory Leaflet 1024

50. FALLON LE (1963) "Water spreading in Turkana". US Agency for International Development, Nairobi, Kenya

51. FIELD, D.I. & POTERE, J.K. "A handbook of basic ecology for ranch management in Uganda" FAO, Rome.

52. FIELD, D.I. "A handbook of basic ecology for range management in Botswana" Land Utilization Division, Ministry of Agriculture, Gaborone, Botswana.

53. GAY, C. (1965) "Range management why and how". Circular No. 376 (1965). Cooperative Extension Service, New Mexico State University, USA.

54. GRIFFITHS, J.E. "The Climate of East Africa", D.A. Hawkins Ltd., in association with E.A. Literature Bureau Ltd., Niarobi

55. HEADY, H.F. "Range Management in East Africa". Government Printer, Nairobi, Kenya. Reprinted, 1972.

56. HENDERSON, G.R. & PRESTON, P.T. "Fodder farming in Kenya". East African Literature Bureau, The Eagle Press, Nairobi

57. HUMPHREYS, L.R. (1974) "A guide to better pastures for the tropics and sub-tropics" Wright Stephenson & Co., Australia Ltd.

58. HUMPHREYS, L.R. (1974) "Tropical pasture seed production". FAO, Rome

59. IVENS, G.W. "East African weeds and their control". Oxford University Press.

60. IVENS, G.W. "Results of bush control experiments: regrowth of Acacia species after cutting at different seasons". Report to Range Management Division, Ministry of Agriculture, Kenya (AGP:SF/KEN 11)

61. IVENS, G.W. et al. "Bush control" UNDP/FAO. AGP:SF/KEN 11, Tech. Report, 1 FAO, Rome

62. LIND, E.M. & TALLANTYRE, A.C. "Some common flowering plants of Uganda" Oxford University press

63. LITTLE, E.C.S. (1972) "Kenya bush control" Report from UNDP/FAO. AGP:SF/KEN prepared for Government of Kenya

64. MCILROY, R.J. "An introduction to tropical grassland husbandry". Oxford University press.

65. MCVICAR "Approved practices in pasture management".H.K. Lewis & Co. Ltd.

66. MUNSELL. "Soil colour charts". Munsell Colour Company, Baltimore 18, Maryland.

67. NAPPER, D. "Grasses of Tanzania" Government Printer, Dar es Salaam

68. PRATT, D.J. (1966) "Bush control studies in the drier areas of Kenya" Blackwell Scientific Publications, Oxford, England

69. PRATT, GREENWAY & GWYNNE "A classification of East African rangeland, with an appendix on terminology" J. Appl. Ecol. 3, 369-382. Blackwell Scientific Publications, Oxford

70. RISOPOULOS, S.A. "Management and use of grassland (Congo)" FAO, Rome

71. STOKES, LARSON & PEARCE "Range improvement through water spreading" Superintendent of documents; US Government Printing Officer: Washington 25 D.C.

72. STODDART, L.A., SMITH, A.D. & BOX, T.W. "Range Management" McGraw-Hill Book Co., N.Y., USA, 1975

73. VALLENTINE, J.F. (1971) "Range development and improvement" Brigham Young University Press, Utah, USA

74. VAN ARKEL, H. (1973) "An introduction to pasture agronomy for beef ranching in Uganda". FAO, Rome

75. VAN RENSBURG, H.J. (1969) "Management and utilization of pastures" East Africa FAO Pasture and Fodder Crop Studies, No. 3

76. VAN RENSBURG, H.J. (1971) "Range ecology in Botswana" FAO/UNDP Project 359. Tech. Doc. No. 1

77. VERDCOURT & TRUMP "Some poisonous plants of East Africa". Collins, London.

78. VOISIN, A. "Better grassland swards" Crosby Lockwood, London

79. WENDT, STOBBS, TILEY & TUCKER (1970)"Pasture handbook" Dept. of Agriculture, Ministry of Agriculture and Forestry, Entebbe, Uganda

80. WHITEMAN, P.C., HUMPHREYS, L.R., MONTEITH, N.H. et al (1974) " A course manual in tropical pasture science" Watson Ferguson, Brisbane.

81. WHYTE, R.O., MOIR, T.R.V. & COOPER, J.P. "Grasses in Agriculture" FAO, Rome

82. WHYTE, R.O. & NILSSON, Et al. "Legumes in Agriculture", FAO, Rome

83. (1964) "A glossary of terms used in range management". Range term glossary committee; D.L. Huss, Chairman. American Society of Range Management, P.O. Box 5041 Portland, Oregon.

84. (1971) "Guidelines for improving livestock production on rangelands" Technical series paper No. 2, Bureau for Technical Assistance, Agency for International Development, Washington

85. "Handbook of Range Management (Near East and Southern Asia) Compiled by Office of Food and Agriculture, International Co-operation Administration, Washington, D.C.

86. "National Handbook for range and related grazing lands" US Department of Agriculture Soil Conservation Service. No. S.C.S. Range-7-67

87. (1963) "Range Research Methods" Miscellaneous Publication No. 940. US Dept. of Agriculture Forest Service.

88. (1975) "Refresher training course in management of improved tropical pastures" Australian Institute of Agricultural Science, Queensland Branch.

89. (1970) "Sub-tropical pasture species" Bank of New South Wales

90. "The flora of Tropical East Africa: Leguminoseae; parts 1-4 " Government Publishing Agency, P.O. Box 1801, Dar es Salaam

91. "The use and misuse of shrubs and trees as fodder" Bureaux of Pastures and Field crops" Commonwealth Agricultural Bureau, Hurley, Berk., England

M-11
ISBN 92-5-100565-6