RESEARCH NOTES

In this section the results of some recent research into the management of sourveld and planted pastures in the humid regions of southern Africa are presented. Also presented is a software package which integrates the biology and economics of rangekands.

PATCH GRAZING IN THE HUMID GRASSLANDS OF KWAZULU-NATAL

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Patch grazing has rarely been quantified even though it is a common occurrence and may be linked to veld degradation in the humid grasslands of KwaZulu-Natal. We therefore need to look at grazing patterns and evaluate current grazing recommendations in an attempt to alleviate the problem of continued patch grazing which may be the focus of veld degradation.

- **A primary reason animals patch graze is in order to obtain forage that is physically and nutritionally more attractive to the animal than the surrounding sward.** Numerous reasons could be put forward as to why patches are more attractive to the animal. My study (1992-1994) showed that soils in patches were higher in nutrient content which may cause the sward in patches to be more attractive than the surrounding sward. Urine deposition also strongly influenced grazing due to the increase in the nutrient content of the herbage. Urine could arguably be the most important factor in patch initiation and consequent patch development.

- **Once an animal has grazed a patch, for what ever reason, the patch will continue to be regrazed because the patch would now contain regrowth which is higher in nutritional value than ungrazed areas.** Animals will graze a previously grazed patch in preference to an ungrazed patch even if the patch contains plants not usually grazed by the animal. Patch grazing is therefore an interaction between the variability in sward characteristics (largely due to the variability in the micro-environment) and the grazing animal. However, nothing practical can be done to eliminate urine and dung deposition, and variations in the soils are likely to occur naturally.

- **Patch grazing was most evident during summer and autumn.** Patch grazing greatly depletes stored reserves of plants in patches while the non-patches seem unaffected. Autumn is a critical period for photosynthate storage and an autumn rest may have to form a component of any grazing system to enable plants in patches to recover, and thereby decrease the potential for patch degradation.

- **Early grazing after burning in early spring (*c.* two weeks) also promotes a more even utilization of the sward than later grazing commencement.** With increasing delay in grazing after a burn the severity of patch grazing increases. The more uniform sward, as a result of early stocking after burning, also decreases any carry-over effect patch grazing may have, and thereby decreases the potential for patch grazing in the grazing season.

- **During winter non-patches were grazed more frequently and intensively than patches.** Therefore, grazing during this period may decrease the potential carry-over effect even further. Winter grazing has no long-term effect on the sward, and increasing the stocking rate at this time would further decrease the carry-over effect and therefore the potential for patch grazing in the following grazing season. As the sward becomes dormant towards winter in the humid grasslands of KwaZulu-Natal animals start losing condition and weight. A protein-rich winter supplement therefore has to be used to ensure that animals do not lose to much weight. Heavy overwintering with a winter lick may greatly decrease the potential for patch grazing in the following grazing season by decreasing the carry-over effect that patch grazing may have on the sward.

- **The potential for patch grazing may be decreased by a slight modification of the currently recommended four-camp system.** The first grazing season could start early to reduce patch grazing in the first grazing season and to reduce the carry-over effect into the second grazing season. In the second grazing season an autumn rest could be introduced to allow the plants in the patches to recover in vigour and thereby reduce the potential for patch degradation. Heavy grazing during winter could then reduce the carry-over effect into the third grazing season. Having reduced patch grazing going into the third grazing season and allowed plants in patches to recover, the third grazing season could then be grazed normally as a full season's rest would follow.

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SHORT-TERM EFFECTS OF GRAZING CATTLE TOGETHER WITH SHEEP IN HIGHLAND SOURVELD

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The continued retrogression of veld in many areas of southern Africa is perceived to be a function of farm management practices. The high-elevation, sour-grassveld areas on the eastern seaboard of South Africa (hereafter referred to as sourveld), where sheep form an integral part of the livestock production system, are no exception.

While the sourveld is considered to have the highest grazing capacity of any vegetation type in southern Africa, a major constraint to livestock production is that the sward becomes increasingly unpalatable and its nutritional value declines as it matures. Cattle are well adapted to grazing low quality forage while sheep are less well adapted, requiring high quality, short, leafy grazing for satisfactory livemass gains. As the growing season progresses, growth rates decline and so the proportion of high quality short, leafy herbage in the sward decreases. Sheep then become increasingly selective in their grazing as they attempt to meet dietary requirements.

Management practices commonly applied in sourveld grazed by sheep include 1) annual burning and 2) continuous grazing (as soon after the burn as possible) at stocking rates which maintain the sward in a short, palatable and nutritious state. Veld management is therefore aimed at providing sheep with immature, high quality herbage in an attempt to achieve maximum wool and mass gains and thus maximize financial returns.

There is, however, a large amount of circumstantial evidence indicating that such management is responsible for the deterioration in veld condition in sheep producing sourveld areas. O'Reagain and Turner (1992), who present a comprehensive analysis of grazing trials which have been conducted throughout southern Africa, support this observation in concluding that sheep, which graze more selectively and more closely than cattle, have greater potential for causing veld degradation than do cattle.

To limit the negative effects of sheep on veld condition it is generally recommended that they should be grazed together with cattle at a ratio which favours cattle or, at worst, at a ratio of 1 LSU cattle to 1 LSU sheep - or one mature steer to 6 mature sheep. These recommendations are based on the assumption that, provided the correct stocking rate is applied, the less-selective grazing habit of cattle should ensure that the sward will be maintained in a state suited to the requirements of sheep.

The recommendations were tested in a research program which was undertaken at the Kokstad Agricultural Research Station in East Griqualand. A four-paddock rotational grazing management system, which is generally recommended for the area, was applied. The results and recommendations after four years of running the trial are summarised below.

- **In all grazing seasons, as the proportion of cattle in the species mix increased, sheep performance increased.** A decline in sheep performance was recorded in each ratio treatment from the first to the third season. This decline was attributed to the increased maturity and thus lower quality of herbage on offer to the sheep, and the fact that only one paddock available to the animals in the second and third grazing seasons had been burned prior to the start of the season. Sheep performed best during the season which had the lowest rainfall where herbage quality was maintained for longer into the grazing season than in previous seasons.

- **In contrast, cattle performance was affected by the stocking rate (animals ha^{-1}) of cattle rather than the presence of sheep.** As the quantity of herbage on offer per steer declined steer performance declined.

Regarding the impact of grazing on the sward, results of the trial provide strong indications that:

- **in the long-term, the current recommendations of grazing cattle together with sheep in order to prevent the degradation or loss of veld condition which occurs in sheep-only grazing systems, will not succeed.** A four-paddock rotation grazing system does not appear to be an appropriate veld management system for sustainable sheep production in sour grassveld.

  An alternative approach to veld management is suggested in which the sheep are confined to only those areas of the farm which were burnt at the start of the grazing season. Ideally, sheep should not allocated to the same paddock for two consecutive grazing seasons and the paddock which was grazed by sheep should be provided a full season's rest in the following season

The trial also provided data which was used to evaluate the use of large stock units (LSU) in the definition and application of the grazing capacity concept. Results indicated that:

- **cattle and sheep cannot be equated in terms of LSU when referring to the impact of grazing on the veld.** It is suggested that the definition of grazing capacity should include the species of livestock and assume a grazing management system appropriate to the grazing habit of the animals concerned.

Reference

O'Reagain PJ & Turner JR 1992. An evaluation of the empirical basis for grazing management recommendations for rangeland in southern Africa. J. Grassl. Soc. south. Afr. 9:38-49.

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Bull. Grassld Soc. Sth Afr. 6(2) (1995)

THE MANAGEMENT OF GRASS/CLOVER PASTURES IN KWAZULU-NATAL

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With the political changes taking place in South Africa, we can expect a dramatic increase in international trade in the next few years. However, at this stage price structures within the farming community dictate that many agricultural products can be imported cheaper than they are produced locally (*i.e.* milk from New Zealand). As nitrogen (N) fertilizer is often the largest input cost in intensive pasture systems, most first-world economies opted for legume-based pastures almost 20 years ago. It was in this era that South African scientists presented the need for a switch to legume-based pastures, with many "landmark" symposia and papers being presented. However, due to political isolation, artificial market protection, ample available land and price-fixing, South African farmers were not forced into this option, finding the use of "bag" nitrogen a far simpler means of increasing pasture production. Perhaps, now that the pressure of international trade is upon us, the time is right to again promote the use of legumes in pasture systems.

In intensive, irrigated pasture systems in the higher rainfall areas of KwaZulu-Natal, white clover is the most popular and viable legume of choice. Managed correctly, the inclusion of clover into a grass pasture will improve the protein and energy value of the overall pasture and, without "bag" N fertilizer, will fix substantial quantities of atmospheric "free" N. Typically, however, the grass/clover mixture will require more intensive pasture and animal (bloat) management than a pure grass pasture; perhaps another reason for their avoidance by many farmers.

As a rule, grass/clover pasture management should aim at managing the clover rather than the grass, as the clover is usually the more sensitive of the two. The root system of white clover is not very extensive and is seldom deeper than 10 - 15 cm. As a result, white clover is more sensitive to moisture stress and, as the roots do not exploit the soil effectively, more sensitive to nutrient deficiencies than are most companion grasses. In addition, clovers are more sensitive to the high soil acidity and aluminium toxicity (Al^{3+}) encountered in the higher potential soils of KwaZulu-Natal. Soil pH levels of 4.2 - 4.5 (KCl), acid saturation percentages between 40 - 60% and Phosphate (P) levels of 2 - 8 mg/ml are commonly encountered in these highly leached soils.

If clovers are to be given a fair trial, it is important that careful attention is paid to correct soil fertilization procedures and irrigation scheduling. It is of little value, in an article such as this, to prescribe a general fertilizer recommendation for clover survival when, for a negligible fee and a little effort, a detailed and accurate fertilizer recommendation may be obtained from the Cedara Fertilizer Advisory Service.

Under ideal conditions, clovers may fix up to 250 kg N/ha/yr of "free" nitrogen. However, it is important to understand the limitations on this process, in order to adjust pasture management accordingly.

Some basic principles apply, namely:

- For clovers to effectively fix N the soil pH(KCl) must be between 5.0 - 5.5;
- to ensure clover longevity, soil acid saturation must be 0% and soil P maintained at levels optimum for the bulk density/clay content of the soil (the Cedara Fertilizer Advisory Service will provide these levels);
- ensure that the pasture is never moisture stressed, and
- to optimize legume N fixation, "bag" N fertilizer should not be applied during active clover growth. Conversely, if grass growth is possible when the clover is dormant (*i.e.* late winter/early spring in an annual ryegrass/clover pasture), applications of 25 - 50 kg N/ha (90 - 175 kg LAN/ha) will boost grass yields, to great economic benefit, while not affecting the clover component. In addition, one or two autumn applications of N (25 - 50 kg N/ha) will boost autumn grass production, which may be "carried" into the winter.

Grazing management is also important for clover survival, which in turn is affected by the species of grass used in the grass/clover mixture. Clover survives better when planted with a tufted grass (*i.e.* annual ryegrass, tall fescue, perennial ryegrass) than when planted with a creeping grass (*i.e.* kikuyu, coastcross II). Within the tufted grasses, clover is more compatible with both tall fescue and annual ryegrass, than with perennial ryegrass. Tall fescue and annual ryegrass are both deeper rooted than perennial ryegrass and form a more open tufted sward, as opposed to the shallow rooted (same as clover, thus competing for nutrients and water) and densely tillered perennial ryegrass. A more uprightly-tufted or open grass sward allows more space between tufts for the clover to colonise. The use of clover in a creeping grass pasture (*i.e.* kikuyu) is less popular, as kikuyu is normally grown dryland and on relatively acid soils (30 - 40% acid saturation). Clover can make a substantial contribution to the N status and protein quality of a kikuyu pasture, however, both lime and supplementary irrigation would have to be supplied in reasonable quality. This input cost may not be always justified.

Grazing management, of a grass/clover system, must aim to keep the pasture short (down to 5 cm) on a 21 to 28 day grazing cycle. If continuous grazing is applied then the pasture must be still be kept short (5 - 8 cm). Strict adherence to this grazing strategy is more important in the warm season, while clover is actively growing, than in the cool season when clover is more dormant.

CONCLUSION:

- **if we are to follow the trends of the agriculturally advanced countries worldwide, and compete economically with them, then grass/clover pastures are definitely the path of the future.** The time has passed for the farmer to use the excuse of the bloat hazard associated with clover. Agricultural research at Cedara, and elsewhere, has repeatedly shown that, by following certain basic grazing and animal management procedures (*i.e.* never allow hungry animals free access to a grass/clover pasture), bloat may be avoided altogether. With such fears laid to rest, the improvement in animal performance and savings in N fertilizer will soon convince farmers of the value of including a legume in their grass pasture systems.

MANAGEMENT OF A TALL FESCUE PASTURE

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The management of tall fescue is complicated by numerous factors, such as changes in growth rate, decline in quality as the herbage matures and changes in its sensitivity to grazing. The influence of these and other factors vary with changes in the season. For this reason a flexible management approach, based on seasonal changes, must be adopted when managing fescue. Management recommendations for the four seasons will be given below, beginning with autumn management. The recommendations made are based on recent research results, as well as on a review of the available literature.

During autumn fescue grows rapidly and is very resistant to grazing. Grazing should be severe (six to eight cm), while the grazing frequency will depend upon the growing conditions, but should be approximately every 21 to 25 days. Following each grazing a dressing of 40 to 50 kg N ha^{-1} should be applied. As day length declines plant growth rate declines, but tiller initiation (production) increases. To allow for maximum tiller production the last autumn grazing should be taken at the end of April or early May, after which a dressing of N must be applied and the pasture closed for winter. This final N dressing is important to ensure maximum tiller production during early and late winter. The tillers produced during early and late winter are important for plant survival and maximizing seed production.

Due to the low winter temperatures common in KwaZulu-Natal fescue plants become dormant, consequently, very little management is required. Peak tiller production occurs during the winter period, but besides for ensuring an adequate supply of N for tillering nothing else can be done. At the end of winter the pasture must be grazed short to remove all the herbage accumulated during winter.

The spring period is characterised by high herbage production, flowering and high nutrient demand. This is a extremely stressful period for the plants and is accompanied by high tiller mortality. Tiller mortalities are expected to remain high irrespective of whether the pasture is grazed or closed for seed production.

If fescue is to be effectively utilized as grazing during spring, frequent (17 to 21 days), severe (6 to 8 cm) grazing will be necessary. Such frequent, severe grazing will prevent the herbage from maturing and will remove the tiller apices from most of those tillers which become reproductive, thereby maintaining herbage quality. It is essential that a dressing of N (40 to 50 kg N ha^{-1}) is applied after each grazing. The last spring grazing should be taken in mid November at the latest.

For seed production from fescue the pasture can be grazed until mid to late August and then closed until after seed harvest. The last grazing before closing the pasture down must be severe and followed by a dressing of N (40 to 50 kg N ha^{-1}). A further N application at seed fill will be beneficial. Depending on the season and cultivar planted, seed should be ready for harvesting by early December.

The summer period is the most crucial management period of fescue if its longevity is to be maintained. Fescue is extremely susceptible to poor management at this time due to it having recently passed through a period of active growth and flowering, and due to the high temperatures prevalent in KwaZulu-Natal during summer. Being a temperate pasture species fescue is sensitive to these high summer temperatures and may become dormant. Furthermore, heat stress is reported to increase the alkaloid content (perloline in particular) of the herbage reducing its palatability. The situation is exacerbated by N fertilization, therefore, it is not recommendable to apply N fertilizer in summer. Fescue is intolerant of grazing at this time and will be permanently damaged if grazed severely and frequently. Grazing (particularly with sheep) should be avoided, but if grazed these grazing must be lenient and infrequent. A cover of at least 10 cm of herbage should be maintained throughout summer. Due to the low quality of fescue herbage during summer it is not suitable for utilization by lactating animals.

For maximising seed or herbage yields the pasture should be planted in 30 cm spaced rows at a seeding rate of 5 to 10 kg ha^{-1} under strategic or full irrigation. Under dryland conditions a wider row spacing and/or lower seeding rate should be used for seed production, while seeding rate must be increased for a pasture that is to be grazed.

Future research

- Cultivar improvement research must continue, with the aim of improving herbage quality as well as seedling vigour.
- The effect of grazing on fescue plants needs to be examined further, particularly its effect on tiller mortality during spring.
- A more detailed study of close-down time for seed production is required to identify the best possible close-down time.
- Further seasons seed yield data from fescue need to be collected so that it can be determined whether fescue seed can be produced economically in KwaZulu-Natal.

I feel that there is much information available on tall fescue management, but this information is not reaching the farmers. It is no use designing new research programmes if the information we already have is not been effectively communicated to the relevant people.

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THE PRODUCTION AND USE OF FOGGAGE IN SOURVELD

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Introduction

Foggage refers not only to the end product but also to the *practice* of closing (or 'putting up') a pasture and allowing it to grow out in the late summer and autumn, to be grazed as a standing crop during the periods when pasture growth is slow or has stopped (in the dormant season). 'Put-up' refers to the time in the growing season when the farmer decides to close the pasture and prevent any further grass removal by grazing or mowing. When a pasture is 'put-up' it should be cleaned off, either by 'mob grazing' or by mowing. This is done to ensure uniform defoliation so that the pasture grows out evenly for the remainder of the growing season. The pasture would normally be top-dressed with a nitrogenous fertilizer when 'put-up' to maximize foggage production.

Why foggage?

Overwintering of cattle and sheep is expensive and requires major management inputs from livestock producers in the summer rainfall parts of the country. This is particularly true for the extensive grazing areas in mixed- and sourveld. While the veld in such areas provides excellent grazing during late spring and summer, and adequate grazing in autumn, the nutritive value of grass in winter is poor. Almost all types and classes of livestock lose weight and condition if they remain on such veld during winter. Traditionally, 'trek-farming' and the use of hay, silage and crop residues (largely maize residues) have formed the bulk of the fodder bank for use by livestock during winter. However, with the increasing value of land (and the associated need to maximise financial returns per hectare) the 'trek-farming' practice has become less profitable. Furthermore, the cost of producing hay and silage, and the difficulty of producing hay in high rainfall, moist conditions during summer, point to the need for an alternative source of winter feed.

Foggage production is not restricted to dryland pastures and may form an important component for intensive livestock production systems based on irrigated temperate pastures. Whilst temperate pastures have the physiological potential to grow through winter, growth is often extremely slow or ceases altogether during the coldest periods. Foggage is therefore often produced from temperate pasture species during the autumn, to carry high producing animals through the winter. In winter rainfall regions, excess spring growth of temperate species may be foggaged for use during the dry summer months.

Species suited to foggage production

In southern Africa, Smuts finger grass (*Digitaria eriantha*) and Kikuyu (*Pennisetum clandestinum*) are most commonly used for foggage production. Included in the sub-tropical (summer growing - winter dormant) species most suited to foggage production are Smuts finger grass, Kikuyu, Guinea grass (*Panicum maximum*), Dallis grass (*Paspalum dilatatum*), Rhodes grass (*Chloris gayana*) and Nile grass (*Acroceras macrum*).

Temperate (spring, winter and autumn growing) species suited to the production of foggage include Tall fescue (*Festuca arundinaceae*) and Cocksfoot (*Dactylis glomerata*). Foggage may also be made from annual ryegrass (*Lolium multiflorum*) and perennial ryegrass (*L. perenne*), but these latter two pastures should be used within three months of 'put-up' to avoid deterioration of the foggage resulting from the development of mould and rotting of the lower leaves.

Fertilization

Of the fertilizers applied, nitrogen (N) is the most important and, provided the other nutrients (especially potassium (K) and phosphorus (P)) are in adequate supply, has a major effect on foggage production. The amount and timing of N application are important in regulating the quality and quantity of foggage produced.

Grazing management

Foggage is presented to animals as 'standing hay'. There are often differences in the quality of herbage between the canopy and the lower plant parts of foggaged pastures. In areas prone to heavy frosts, the pasture canopy may be frosted while many of the leaves at ground level remain green. Such green herbage will provide a feed of higher quality than the frosted herbage. Foggaged kikuyu pastures often exhibit this characteristic.

In utilizing foggage, strip, or high intensity grazing is most commonly recommended. Strip grazing allows for more efficient utilization of the available dry matter and for rationing the feed supply. A back fence is not normally necessary when strip grazing dormant, sub tropical pastures whereas a back fence should be used when strip grazing a temperate pasture. It should be noted that even if the foggage is strip-grazed a wastage factor of between 25 and 35% of total dry matter on offer would be expected. Such wastage occurs as a result of i) trampling, ii) fowling and iii) rotting of the herbage, as well as poor acceptability and palatability of the stem material. Animals may also avoid grazing the foggaged material as a result of an accumulation of dust on the herbage and when a flush of new growth occurs in late winter/early spring. These factors must be taken into account when calculating the number of animals that can be carried on a particular area of foggage.

Animal performance

Correct management and selection of pasture species for foggage production will produce herbage of relatively high quality, capable of supporting growing animals and dry stock with little or no supplementation.

Foggage produced from grasses such as tall fescue and perennial rye grass have been used successfully to support ewes and lambs during the autumn and winter months with highly acceptable lamb weaning weights whilst maintaining ewe condition. Cocksfoot pastures are also used as foggage for autumn lambing and for cattle production systems. Mass gains of 0.2 to 0.6 kg per head per day have been recorded for weaner steers grazing foggaged tall fescue pastures.

Animal performance on foggage produced from sub tropical pasture species varies widely according to 'put-up' date, time of use of the foggage and local environmental conditions. When the foggaged pasture is grazed before the grass frosts off and/or becomes dormant, excellent animal performance has been obtained from kikuyu and smuts finger grass pastures. Moreover, in high rainfall areas which are relatively free of frost, good animal performance has been obtained on foggage grazed through the dormant season (June to August). For example, heifers on foggaged kikuyu pastures have achieved gains of 0.6 kg per head per day at Cedara while average daily gains of 60 to 80 g per sheep were obtained from foggaged kikuyu and paspalum pastures in the eastern Transvaal Highveld. In general, however, subtropical pastures which are 'put-up' early in the growing season provide only for the maintenance requirements of cattle and sheep during the winter months, whilst pastures which are 'put-up' later in the growing season allow for modest livemass gains.

Advantages and disadvantages of foggage

Advantages

- No transport or handling costs represent savings on machinery and labour (compared with hay and grass silage),
- the provision of out-of-season grazing,
- excess summer growth can be saved for use during winter,
- a relatively dependable production based mainly on summer rain (whereas satisfactory production of greenfeed (e.g. oats) is dependant on autumn rains and conserved moisture,
- foggage produced from subtropical pasture species provides feed which will, at least, maintain animal mass through the winter months without supplementation, thus providing a saving on bought feeds. Foggaged temperate pastures provide good quality grazing for producing livestock, and
- in sourveld areas where crop residues are the main source of feed for overwintering livestock, foggaged sub-tropical pastures provide high quality grazing for weaner cattle and autumn lambing ewes during autumn (before the plants become dormant).

Disadvantages

- Foggage can be kept only until active growth commences in spring, otherwise the pasture deteriorates, and animal intake is suppressed but the presents of dry, rank and low quality herbage mixed in with the new growth,
- under dry land conditions the amount of foggage produced can be adversely affected by a dry late-summer and autumn,
- un-seasonal winter rain will result in a rapid decline in the quality of foggage produced from sub-tropical species, and
- losses due to weathering and trampling can be high and the foggage is highly susceptible to being lost due to wild fires.

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CULTIVATED PASTURE RESEARCH NEEDS

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The following are priority areas for pasture research in southern Africa:

- **Legumes for different Bioclimates:** species, establishment practices, compatibility with grasses, fertility/fertiliser requirements, defoliation management requirements and livestock production potential. The priority lies in the drier regions of the summer rainfall zone (< 750 mm rainfall).

- **Identification of, and management of, fodder species which provide winter forage.** The species should preferably be able to be utilised *in situ* either by grazing or browsing i.e. no harvesting.

- **Identification of species suited to zero grazing and their management for both developing and commercial agriculture.**

- **Irrigation requirements of different pasture species** - crop factors established for the different species.

- **Practices (species selection, fertilisation, irrigation management) to maximise dry matter production of forage/fodder per unit of water applied.**

- **Assessment of the effects of trampling/compaction by animals grazing cultivated pastures (especially sheep grazing irrigated pastures).**

- **The performance of weaned lambs on irrigated *Lolium multiflorum* and *L. perenne* is disappointing.** There is a need to identify reasons for this and establish practices (species, management) to improve the productivity of weaned lambs on these intensive pastures.

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APPLICATION OF RANGEPACK HERD-ECON TO SOUTHERN AFRICA RANGELANDS

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Introduction

Range scientists have devoted considerable effort attempting to understand how rangelands function, and to subsequently convey these ideas to producers with the hope that this will foster sustainable land management. This approach has often failed simply because it does not consider the financial consequences of various management practises. Computer-based decision-support tools provide a useful interface between research and management, which can integrate the biology and economics of rangeland systems. RANGEPACK Herd-Econ is an example of a microcomputer-based software tool designed to assist managers with strategic and tactical decision making under uncertain conditions (Stafford Smith DM & Foran BD 1990).

Model structure

Herd-Econ consists of a series of biological and financial windows into the property. The user creates various classes of stock, e.g. cows, calves, steers, heifers, bulls, and provides basic biological information such as growth rate, reproductive rate and mortality information for each class. These data can be given for four year types (good, okay, poor and bad), allowing the user to modify production parameters in relation to seasonal conditions. Regular transfers between classes, e.g. calves to heifers and steers, are entered, as well as regular purchases and sales of stock, e.g. "sell 50 percent of all steers aged 2 to 3 years of mass 350 kg in December". Corresponding financial information, including detailed fixed and variable costs, may be added at various levels of detail to customise the setup for an individual property. For example, animal husbandry costs may simply be provided as a total, or broken down into detailed components. Costs are by default fixed, i.e invariable in relation to stock number, but the user may specify costs which should be variable to allow for flexibility at various scales of operation. An interactive command window allows the user to create command files which create further flexibility. For example, the user may create sequences of year types based on historic or probalistic rainfall and examine the consequences of various management options. The outcomes may be viewed in a simple graphics window or exported to other software for detailed analysis.

Applications in commercial agriculture

Herd-Econ has proved particularly useful for assessing the consequences of different stocking strategies in variable environments in Australia for both cattle (Foran & Stafford Smith 1991) and sheep enterprises (Stafford Smith & Foran 1992). Herd-Econ would be extremely useful for southern African situations where similar climatic variablity presents major challenges for livestock producers. While some of the cost descriptions may appear unfamiliar to South African users, the outcomes and relative effects of various management strategies would provide a useful planning tool for producers.

Use of Herd-Econ by pastoralists themselves in Australia remains limited largely due to the time and effort required to master the program, and by the small proportion of farmers actively using computers in management. Herd-Econ is consequently used primarily by extension personnel attached to government agencies, and by consultants. Similar limitations are likely to occur in South Africa. However, declining real cost of computers and increasing cost:price squeezes are likely to see increased application of computers in agriculture and increased demand for decision-support software in the future.

Applications in communal rangelands

Recent political change in South Africa has seen considerable emphasis placed on agriculture, and particularly rangelands, in the communal areas of the country. In Australia, recent legislation has resulted in increasing land ownership by Aboriginal people. Stafford Smith *et al.* (1994) used Herd-Econ to examine various land use options for Aboriginal communities based on commercial use objectives. In South Africa, the Land Restitution Act and Pilot Land Reform Programme have resulted in black communities receiving increased access to land and natural resources. Development agencies have become active in providing agricultural advice to communities on newly-acquired land. This trend is likely to continue as the Land Reform Programme is effected. What possible roles could Herd-Econ play in the communal rangelands of southern Africa? I attempted to answer this question while on sabbatical leave at the CSIRO Centre for Arid Zone Ecology in Alice Springs, Australia.

The effect of various biological parameters on herd dynamics may be assessed within Herd-Econ and the output exported as data files to a spreadsheet package. Addition of appropriate economic parameters would allow the user to examine the consequences of various strategies on both biological and economic components of the system. Assessing the consequences of four drought responses for a communal cattle herd in the semi-arid savanna of KwaZulu-Natal (Hatch & Stafford Smith 1995) revealed that moving stock to drought unaffected areas, buying in additional stock after drought or supplementing stock during drought would achieve considerably greater milk yields and net benefit relative to simply doing nothing in the face of drought. Option costs would increase in relation to the type of drought intervention which revealed that moving stock yielded both the greatest net benefit and cost:benefit ratios. Importantly, cost constraints may ensure that communal graziers have little alternative but to do nothing in the face of droughts.

Thus Herd-Econ could prove to be a useful planning tool for development agencies and perhaps avoid some of the past costly development failures in African pastoral systems.

Conclusions: future developments

Rangeland scientists have concentrated on the ecological aspects of rangeland management but have failed to adequately address integration at the economic level. This level of integration is crucial to the range manager and fundamental to the success of research and extension effort. RANGEPACK Herd Econ provides a useful medium for integrating these factors.

Future developments of the Herd-Econ approach include integration into detailed biophysical (GRASP - McKeon et al. 1990) and financial models (RISKFARM - Milham et al. 1993). The

RISKHerd model (Milham et al. 1995) effectively links relationships between grass growth, animal production, financial return and after-tax whole-farm budgets for various strategies allowing the assessment of the effect of government policy on sustainability. Integration of these concepts into poorly understood communal rangeland systems could have major implications for government policies on communal rangelands in South Africa.

References

Foran BD & Stafford Smith DM 1991. Risk, biology and drought management for cattle stations in Central Australia. *J. Environ. Manage.* 33: 17-33

Hatch GP & Stafford Smith DM 1995. The bioeconomic implications of four drought response options for a communal cattle in the semi-arid savanna of KwaZulu-Natal. Unpublished paper, Department of Grassland Science, University of Natal, Pietermaritzburg.

McKeon GM, Day KA, Howden SM, Mott JJ, Orr DM, Scattini WJ & Weston EJ 1990. North Australian savannas: management for pastoral production. *J. Biogeog.* 17: 355-372

Milham N, Hardaker JB & Powell R 1993. RISKFARM: A PC-based stochastic whole-farm budgeting system. Centre for Agricultural and Resource Economics, University of New England, Armidale

Milham N, Stafford Smith DM, Douglas B, Tapp N, Breen J, Buxton R & McKeon G 1995. Farming and the environment: an exercise in eco-economic modelling at the farm-level in the NSW rangelands. An invited paper presented at the International Congress on Modelling & Simulation, University of Newcastle, Callaghan

Stafford Smith DM & Foran BD 1990. RANGEPACK: the philosophy underlying the development of a microcomputer-based decision support system for pastoral land management. *J. Biogeog.* 17: 1-6

Stafford Smith DM & Foran B 1992. An approach to assessing the economic risk of different drought management tactics on a South Australian pastoral sheep station. *Agric. Sys.* 39Z: 83-105

Stafford Smith DM, McNee A, Rose B, Snowdon G & Carter CR 1994. Goals and strategies for Aboriginal cattle enterprises. *Aust. Rangel. J.* 16: 77-93

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DIARY

15-16 February 1996: RADAR BRIEF. CSIR, Pretoria, South Africa. The theme is Radar imagery: essential geo-information for southern Africa. The programme will highlight the complementarities and differences between optical remote sensing techniques and synthetic aperture radar, and will focus on current and future applications (e.g. marine surveillance (shipping, oil), oceanography, hydrology, geo-exploration, crops, forests and vegetation mapping. It is organised under the auspices of the Satellite Applications Centre of the CSIR and features top speakers from the British National Remote Sensing Centre(NSRC), the European Space Agency (ESA), RADARSAT International (RSI, Canada) and SPOT Image (France).

The registration fee of R475-00 per person, covers attendance, documentation, courtesy transport from an appointed hotel, teas, lunches and a cocktail reception. Contact: Conference Planners, PO Box 82, Irene 1675, South Africa. Tel: (012) 63 16 81; Fax: (012) 63 16 80.

19-21 February 1996: Geo-information for Problem Solving in the Developing World. CSIR Conference Centre, Pretoria, South Africa. EDIS 96, P.O. Box 69 Newlands 7725, South Africa. Tel. 021-685 4070 (Rob Truter).

15-22 March 1996: Remotely Sensed data and GIS in Environmental and Natural resources assessment. RS Conference, Harare, Zimbabwe. Tel. (604) 231 4900 Fax. (604) 231 4922.

26-30 March 1996: Second European Symposium on Rural Land Farming Systems Research. Granada, Spain. Dr. Werner Doppler, Institute of Agricultural Economics and Social Sciences in the Tropics and Subtropics, Universität Hohenheim, D-70593 Stuttgart, Germany. Tel. (49)-711-459 2514 Fax. (40)-711-459 3812.

1-4 April 1996: All Africa Conference on Animal Agriculture. Pretoria, South Africa. Miss Una Wium, Professional Conference Services, P.O. Box 95557, 0145 Waterkloof, Pretoria, South Africa. Tel. (27)-12-46-5453 Fax. (27)-21-46 5453.

9-11 April 1996: Sustainable use of wildlife. University of Cape Town, Cape Town, South Africa. Hosted by The Southern African Wildlife Management Association.

15-18 April 1996: Moving towards a Decade of Promise after a Decade of Achievement. International conference organized by the French Space Agency, CNES, for the 10th anniversary of the launch of SPOT-1 in February 1986. Paris, France. SOCFI/SPOT, 14 Rue Mandar, f-75002 Paris, France. Te.+331 44 88 25 Fax. +331 40 26 04 44.

16-19 June 1996: International Congress for Computer Technology in Agriculture (ICCTA '96), Information and Communication Technology Applications in Agriculture: State of the Art and Future Perspectives. Wageningen, The Netherlands. A.A. Dijkhuizen, WAU-Department of Farm Management, Hollandswer 1, 6706 KN Wageningen, The Netherlands. Fax. (31)-317 484 763 E-mail aalt.dijkhuizen@alg.abe.wau.nl

23-28 June 1996: Second international Symposium on the Biology of Root Formation and Development. Jerusalem, Israel. Dr A. Altman, P.O. Box 50006, Tel Aviv 61500. Tel. (972)-351-40 014 Fax. (972)-351-40 077.

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