S. Afr. J. Anim Sci. 6, 139–146 (1976)

# THE FUTURE ROLE OF IMPROVED PASTURES FOR BEEF CATTLE

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*The development of improved profit equations for beef production in the Republic has become a matter of vital importance. Not only is the country faced with a projected future deficit in beef supplies, but the profit margin for beef production has dwindled markedly in recent years. A recent investigation revealed that the production costs of the "average" beef farmer in Natal increased by 35 percent during the period January 1974 to January 1976. During this period the average price of beef over all grades on the Durban and Pietermaritzburg markets increased by only 9 percent. The combined effect of these factors on the profit margin has been dramatic.*

The basic problem facing the beef industry at the present time is one of inadequate supplies of the basic raw material in the form of the weaner calf and the development of optimum strategies for getting these animals to market as economically and as soon after weaning as possible. (Harwin & Lombard 1974). Suggested priorities include the following:

a. increasing the proportion of effective breeding cows

b. increasing the output of weaner calves per 100 cows at a reduced cost per breeding unit

c. increasing the total number of breeding cows, and

d. getting market animals to optimum mass and grade as economically and as soon after weaning as possible.

In assessing the situation Harwin & Theron (1975) have indicated that if the above targets are to be met it is vital that increased emphasis be placed on production systems based on the products of grasslands and the effective utilization of crop residues with minimum reliance on grain and the products of arable land. Priority requirements for the beef farmer are therefore to:

i. increase the quantity of forage available per unit area,

ii. improve the quality of herbage presented, and

iii. regulate the distribution of forage products over time.

While the natural grassland will for some time continue to provide the bulk of the forage demands for beef cattle, various authors (Harwin 1974, & Theron 1975) have supported the claim that improved grassland productivity can only come about by the radical improvement of the veld (RVI) and gradual replacement with improved forage crops in strategically well planned and integrated programs. According to these authors a 57% increase in the total annual livemass per hectare can be achieved by the application of simple multicamp layouts and the consequent improved grassland management strategies. A further 273% increase can be generated by fertilizing and oversowing the veld (natual grassland) with improved grasses. A still further 38% improvement can be effected by the conventional total replacement of the veld with improved pastures.

## Radical improvement of the veld (RVI) in the Eastern high rainfall areas of the Republic

This discussion and the results presented are confined essentially to the eastern high rainfall areas of Southern Africa. The climate of this area is characterized by a moderate to high (750 mm) summer rainfall which often occurs as heavy showers and falls over ca. 100 days/annum. While the summer day temperatures are moderate (max. = 32°C) minimum temperatures in winter are low (min. = −7°) and heavy frosts are a regular feature.

The topography in this area is undulating to broken thus precluding extensive cultivation. Soils are often shallow, heavily leached and are acid (pH (KC1) = 4,2 – 4,5) and so correct and adequate fertilization is a prerequisite to successful production.

RVI in practice implies the application of one or more of three basic techniques. The choice of the technique or the combination of techniques used is dependent entirely upon the nature of the requirements of the specific component of the animal production system and the restrictions imposed by the Natural Limiting Factors (soil, slope, soil depth, erodability, water logging and rockiness).

I. *Fertilizing and Oversowing veld (Natural grassland)*

This technique involves the gradual replacement of native grassland through the application of fertilizers followed by oversowing with improved grasses when the veld is in a suitably receptive condition. By this technique fertilizer is used as a production factor to improve both the quantity and the quality of herbage available and secondly, as a tool with which to open up the sward thus making it more receptive to the oversown grass. Clearly fertilizers and animals react and interact with one another to achieve the desired effect. The most significant features of pastures established in this way are as follows.

a. The basic costs involved in constructing contour drains, seedbed preparation and basal liming and fertilizer applications are avoided.

b. No time is lost in generating the pasture.

c. By comparison, maintenance costs are low (ca R55.50/ha/annum).

d. Establishment costs involve only the cost of seed and its distribution.

e. Returns are high. A gross return of R145.38/ha was obtained utilizing only 100 of a potential grazing duration of about 240 days.

f. The grazing season is lengthened and as a consequence the duration of the expensive winter feeding period is reduced.

g. The technique provides the only means of improving the productivity of veld which cannot be ploughed and is already well managed.

h. A simple and highly economical method of generating a highly productive pasture at a minimum cost is provided.

i. The technique should not be used where *Aristida junciformis* is a component of the vegetation or is a potential colonizer of the area.

j. However, where unpalatable grasses such as *Miscanthidium capensis*, *Festuca costata* and species of *Cymbopogon* have been burnt and fertilized, their acceptability to stock has improved so that they are grazed and their general vigour has declined considerably. This is an important consideration as these grasses are becoming serious invaders in many areas.

k. Wherever possible legumes should be established by sodseeding to improve the quality of the pasturage and to reduce the dependence on applied nitrogen. To date oversowing with legumes has not been attempted due to the known specific requirements of legumes for successful establishment and nodulation on acid soils.

Basically the technique of pasture development using this principle is as follows:

i. The area to be fortified should be subdivided into at least six but preferably eight paddocks. If this is not possible then the paddock to be fortified should be treated as a component of a multi-paddock layout.

ii. The vegetation should be burnt off at the commencement of the season and then stocked heavily for the duration of the grazing season with a view to reducing the competitive ability of the veld. Stocking rates usually used are 2,5 to 3 mature livestock unit (mlu) per hectare (ha) for as long as possible during the season.

iii. The area should be top-dressed in spring with about 25 kg P/ha (300 kg super phosphate) and about 100 kg N/ha (220 kg Urea) in two dressings.

iv. In the second or possibly third season, depending upon the success achieved in reducing the vigour of the veld and in opening up the sward, the area should be oversown with a suitable grass such as Cocksfoot (15 kg seed/ha). This is best done by seeding toward the close of the grazing period so that the seed is brought into contact with the ground and if possible buried by trampling.

v. Once seeded, the paddock should be rested for the remainder of the season so as to allow the oversown grass to germinate and to establish itself.

vi. After establishment the oversown veld should be grazed regularly applying the principle involving a short duration period of stay and a long duration period of absence.

vii. Until such time that effective legumes are successfully incorporated into the sward, fertilization at the above rates should continue.

viii. At any stage (even before fertilizing and oversowing) and wherever possible, the veld should be mechanically fortified with a mixture of Ladino white and Kenland red clovers. Once these legumes are established and functional, the dependence of the system on applied nitrogen and also the cost of maintaining the system will be reduced.

In practice the technique is recommended in areas where, due to excessive slope (15%), erodable soils or rockiness, normal tillage operations cannot be applied. Practical experience and the results achieved now clearly suggest that there is no real reason why this technique should not be used as an effective and highly economical method of establishing pasture in areas where conventional techniques could normally be applied. This claim is verified by the results of local large-scale farmer-operated trials.

Murray (1974) has reported in detail on the highly significant increases in carrying capacity achieved on his farm by the application of this technique. During the 1974/75 season the carrying capacity of his veld was increased from 0,6 mlu/ha over about 200 days to 1.60 mlu/ha over 266 days. By this was achieved a 167% increase in carrying capacity and a 33% increase in the duration of grazing at a cost of R0.11 per mlu grazing day. Only two years of treatment was required to attain these production levels. Quite apart from the increased carrying capacity, the increase in the grazing season must be properly evaluated in terms of the saving of conserved winter feed. When taken into account this further reduces the cost of maintaining animals and so improves the efficiency of the production system.

In a similar experiment on the farm of Mr Colin Hully at Balgowan, 60,8 ha of F O F (fertilized, oversown and fortified) grassland was stocked with beef cows and their calves. During the second productive year (1974/75) the trial carried 1.79 mlu/ha over 240 days (429 mlu grazing days per hectare). Assessing the results in greater detail, 95% of the cows reconceived and the daily growth rate of the male calves was 1.43 kg while that of the female calves was 1.38 kg. It is of interest that the growth rate of the 61 best calves was 1,52 kg. The cost of carrying the stock was R0.15 per mlu grazing day.

In the 1975/76 season this experiment was initially stocked with 250 yearlings at a mean stocking rate of 1.97 mlu/ha for 40 days. The mean daily livemass gain for the animals during this period was 1.0 kg. The increase in mass of the animals realized a return of R5 000,00 when sold at the end of the grazing period.

The experiment was then grazed with 23 weaners born in the previous autumn. These calves were carried for 60 days and their daily livemass gain during this period was 0,9 kg. The mass gain during this period realized R621,00. These autumn calves were accompanied on the experiment by 149 "bought in" yearlings. The daily gain of these animals was only 0,7 kg, probably due to the fact that they were not treated for internal parasites. The increase in mass realised R3 129,00 at the local sale.

The total return from the experiment in 100 days was R145,83/ha while the total costs involved in applying fertilizer were R55,49/ha. The margin over costs was R90,34 leaving a further 140 to 160 days at 2 mlu/ha to the credit of the trial.

These results clearly indicate that fertilizing and oversowing veld is a highly effective method of generating high quality grassland at low cost for animals that will respond to high quality grazing.

II. *Fortification of veld and established pastures*

The second technique whereby either veld or established pasture can be radically improved is through fortification by sodseeding. Because the locally available equipment was not able to satisfactorily overcome specific local problems it was necessary to design and construct sodseeding equipment which could introduce seed in a "once over" low cost operation into established grassland. The operation of the sodseeders, which are now commercially available, involves the creation of a limed and fertilized seedbed in which competition from the existing sward is eliminated. In the same operation seed is delivered, buried and the micro-seedbed compacted.

Sodseeding has been successfully used to introduce temporary grasses and legumes into both veld and established pastures. When sodseeding veld or vigorously growing pasture it may be necessary to use a herbicide at a low concentration to assist in reducing the competitive ability of the vigorous established swards. Annual forage crops such as Triticale and Japanese Radish have also been successfully introduced into established swards and veld by sodseeding.

The advantages of reinforcing grasslands by sodseeding are as follows.

a. Sodseeding is a low cost operation which in practice drastically improves the carrying capacity of the veld. At the Tabamhlope Research Station fortification of the veld with red and white clover in rows at 2 m centres was responsible for an increase in the marginal return over costs from R26 to R43. This 67% increase in a cow and calf operation was due to a doubling of the carrying capacity (0,62 to 1,24 mlu/ha), and a slight improvement of the A D G of the calves from 0,70 to 0,75 kg which resulted in an increase of the livemass of calves weaned from 89,5 to 192,8 kg/ha.

b. The botanical components of established pastures can be manipulated at low cost and in a "once-over" operation to meet specific annual requirements without destroying the basic pasture. For instance, kikuyu pastures can be reinforced with temperate grasses and legumes to significantly extend the grazing season both in autum and in spring. Practical experience has shown that this can be as much as two months and that the practice can be used to reduce the area specifically required for temperate pastures. This has the effect of materially improving the efficiency of forage production under intensive conditions where irrigation is available.

c. Sodseeding provides the opportunity of easily introducing well inoculated clover seed into moribund pastures. Through this operation the clover can also be kept infected with efficient strains of Nitrogen fixing bacteria and at the same time the phosphorus status of the soil, which is vital for the efficient growth of clover, can be redeveloped at a minimum cost. An indication of the importance of maintaining the clover component of the sward is provided by the fact that re-inforced kikuyu pastures at Cedara have to date been maintained in an effective condition for three seasons without any additional fertilizer. At the Tabamhlope Research Station an *Eragrostis curvula* pasture fortified with clover consistantly carried growing steers at a rate equivalent to 2,5 mlu/ha for four years. The only maintenance treatment required to achieve this was the annual application of 50 kg K/ha for the first two years after fortification. A further indication of the efficiency of the operation and the importance of clover in the economy of pasture maintenance is given by the fact that topdressings of 115 kg N/ha/annum were required to maintain a grass pasture in the same productive condition as the clover re-inforced pasture. The average daily mass gain of animals grazing these two classes of pasture was the same (0,5 kg).

d. Finally, sodseeding provides an opportunity of improving the productivity of difficult and unmanageable areas. In many instances bottom lands which could not be developed until they are drained or because the erosion hazard is too great have been effectively improved through sodseeding. A sodseeder can be used to developed pastures on shallow soils or steep terrain where normal tillage operations are not possible.

III. *Conventially established pastures*

The most common method whereby veld has been radically improved is by ploughing, the preparation of a fine seedbed and the establishment of a conventionally broadcast pasture. In Natal, in particular, pastures established in this way on cropable soils, are in direct competition with crops used to provide food for human consumption. For this reason recent research has been directed at the intensification and development of pastures of similar production potential at minimum cost on areas which are not normally corpable.

Such areas are those with slopes in excess of 15%, where the topography is generally broken or where soils are shallow, erodable or excessively wet. By developing these low cost minimum tillage pastures it is hoped to minimize the dependence of beef cattle on the products of arable lands without sacrificing too much by way of animal productivity.

By using this technique the cost of pasture establishment and maintenance can be reduced from about R155,00/ha/annum to about R67,00/ha/annum. The characteristic features of these pastures are as follows.

a. Tillage operations are minimized by direct drilling in a once over operation into previously cropped lands or established pastures. Clearly the degree of seedbed preparation will depend upon the prevailing conditions and nature of the pasture required. Low cost pastures have been successfully generated by drilling directly into maize and millet lands cropped for silage as well as established but degenerate pastures.

b. The pasture seed is drilled directly into a microseedbed. By this technique the quantity of grass and legume seed used is reduced to about one third of that usually required.

c. The seed is drilled over banded lime, if necessary, and fertilizer which is incorporated into the microseedbed. Banding the lime for fertilizer minimizes the requirements of fertilizer without jeopardising the productivity of the pasture.

d. Legumes are established in alternate rows with grasses. In doing so interspecies competition is reduced and so the problems involved in managing a mixed pasture are avoided.

e. The inclusion of a legume is vital to the concept of low cost pasture in that the costs of nitrogen topdressings are excluded if the legumes are functionally efficient. The efficiency of the legume in providing the nitrogen requirements of a mixed pasture is dependent upon successful nodulation of the roots by careful inoculation of the seed with a high concentration of *Rhizobium* inoculum. It is estimated that if nodulation is successful and if management of the pasture is optimized, the legume component of a pasture can generate up to the equivalent of 200 kg N/ha/annum and that most of this becomes available to the pasture system.

f. The carrying capacity of successfully established low cost pastures is approximate 2,5 mlu/ha over about 250 days. This compares favourably with the production potential of many conventionally established pastures costing a great deal more to establish and maintain.

The economic feasibility of intensive pastures established on marginal land has been well established. In a co-operative trial in the Tala Valley area of Natal, kikuyu and K 11 Bermudagrass, grown on uncropable soils, and highly fertilized and adequately irrigated have been highly profitable. The estimated cost of these pastures, based on 1976 costing was R401,77/ha while the estimated return from calves weaned from the trial was R586,88/ha. The gross return over costs was therefore R185,11/ha.

In evaluating these data it should be borne in mind that the profitability from the pasture was greatly reduced because the returns were estimated from the weights of calves weaned at the age of 5 to 6 months and removed from the pasture. Had the weaners been left on the pasture for a further 3 to 4 months and the cows removed, then clearly the profits from the pasture would have been considerably greater. When considering the performance of these pastures it is of interest to note that their productivity compares favourably with the performance of high producing tropical pastures grown elsewhere (Theron, Ludorf & Jones, 1972).

At the Tabamhlope Research Station various pastures representing different levels of intensification have been evaluated by comparing the performance of both yearlings and cow and calf herds. The data from these experiments were reviewed and discussed in detail by Harwin & Theron (1975) who concluded that the replacement of the veld with improved pastures resulted in a substantial increase in calf mass per unit area and that this was associated with a reduced cost per cow unit and a substantial increase in the margin over feed costs both per animal and per hectare. In the case of the yearlings the data showed that the most important effect of pasture intensification was a marked increase in the total mass produced per hectare and in the livemass gain per animal. This increase in production was associated with a dramatic increase in profitability.

Recently it has been possible to review the data from these experiments and to compare the effects of the level of pasture intensification on the performance of animals weaned off different classes of pasture, wintered and then grown out on pastures similar to those from which they were weaned.

These data are presented in Tables 1, 2 and 3.

**Table 1**

*Performance of calves grazed with their dams on different classes of pasture*[1]

| Pasture Class | Stocking Rate (cows/ha) | A D G of calves (kg) | Total Calf Mass Gain (kg/ha) | Value of Gain @ 45c/kg R/ha) | Cost of Pasture (R/ha) | Margin (R/Calf) | (R/ha) |
|---|---|---|---|---|---|---|---|
| Veld | 0,62 | 0,70 | 89,52 | 40,28 | 14,52 | 41,70 | 25,76 |
| Reinforced Veld | 1,24 | 0,75 | 192,78 | 86,85 | 43,78 | 34,78 | 42,97 |
| Nyl/Clover | 1,85 | 1,11 | 429,12 | 193,10 | 60,83 | 71,37 | 132,28 |
| Kikuyu | 2,47 | 0,96 | 491,04 | 220,95 | 154,56 | 26,87 | 66,41 |

(1) Cows have been excluded from these calculations

**Table 2**

*Performance of steers raised on different classes of pasture*

| Pasture Class | Stocking Rate (mlu/ha) | Mean A D G (kg) | Total Mass Gain (kg/ha) | Value of Gain @ 45c/kg (R/ha) | Cost of Pasture (R/ha) | Margin (R/Calf) | (R/ha) |
|---|---|---|---|---|---|---|---|
| Veld | 0,64 | 0,44 | 93,71 | 255,96 | 14,52 | 27,97 | 27,65 |
| Reinforced Veld | 2,73 | 0,23 | 168,76 | 214,92 | 43,78 | 7,58 | 32,16 |
| Pasture | 4,29 | 0,40 | 524,71 | 571,41 | 107,44 | 9,17 | 128,43 |

## Table 3

*Performance of steers weaned from and grown out on different classes of pasture (1)*

| Pasture Class | Mean Stocking Rate (mlu/ha) | Total Mass Gain (kg/ha) | (kg/steer) | Value of Gain @ 45c/kg (R) | Margin (R/Steer) | (R/ha) |
|---|---|---|---|---|---|---|
| Veld | 0,63 | 129,11 | 189,0 | 58,10 | 64,64 | 7,36 |
| Reinforced Grassland | 1,99 | 325,68 | 257,7 | 146,56 | 40,65 | 38,17 |
| Pasture | 3,23 | 631,46 | 333,9 | 505,71 | 59,32 | 63,86 |

(1) Including wintering costs and performance

The conclusions which can be drawn from these data are as follows.

i. The marginal financial return from a cow and calf operation increases as the replacement of the veld is intensified and with the inclusion of a legume in the sward. The major effects of replacement are to improve both the performance of the calves and the potential stocking rate.

ii. When the veld is totally replaced with an intensive grass pasture, a higher weaning mass is attained but the margin per animal and per unit area is reduced when compared with that of low cost legume based pastures. When considering the livemass of calf weaned, it is interesting to compare the 491 kg/ha achieved with the claim of Dr. McGinty of Arizona as quoted by Price (1975) that the goal in the U.S.A. should be to produce 1 000 to 1 200 lb of weaned calf mass per acre.

iii. In the yearling phase, although the mean daily gain of the yearlings and the duration of grazing on fortified veld was low, the financial margin was considerably better than that from veld. It should be pointed out that the relatively poor performance of the reinforced veld was due to considerable overstocking due to an over-estimate of the potential of the pasture and the fact that sections of the treatment were from time to time withdrawn to allow further fortification to take place.

iv. When grazed on good quality pasture which is cheap to establish and maintain, weaners can be marketed directly from the pasture with satisfactory results and without necessarily having to resort to feedlot finishing. The data in Table 2 verify this claim. It should be pointed out here that the data indicating the difference between marketing off pasture and finishing in a feedlot would be still greater if the costs involved in establishing and operating a feedlot are taken into account.

v. To derive the maximum benefit from planted pastures it is vital that cows should calve down as early as can be economically justified and that well bred animals which will respond to the improved feeding regimes be used. This claim has been verified by subsequent observations which indicate that a high weaning mass with good quality stock is achieved by early calving.

vi. It is not essential to provide any form of energy supplementation when cows and calves are grazed on planted pastures. On pastures with a high clover component however, it is always advisable to have hay readily available to the stock.

vii. Grazing short clover based pastures should be avoided at all times as this increases the bloat hazard. Grass/clover pastures should always be well grown out and mature when animals are introduced to a new paddock.

viii. Taking all factors into account, the results of trials suggest that a stocking rate of 2 cows and their calves per hectare over the grazing period is optimum for a low cost clover based pasture while 2,5 cows and their calves per hectare seems optimum for fertilized summer grass pastures. Stocking at these rates in the Highland Sourveld provides abundant forage during the season and ensures that the season is lengthened as far as possible without subjecting the production system (and management) to any stress.

ix. Until further evidence becomes available there is no justification for weaning calves while their dams still have adequate milk. This claim is supported by McGinty as quoted by Price who claims that there is no point in weaning a calf at 205 days. It is cheaper to leave the calf on the pasture and that the cow does better with the calf at her side.

x. In the yearling phase an attempt at a practical assessment of the overall situation indicates that the best results in this phase are achieved from low cost pastures with a strong legume component grazed at a moderate stocking rate. This is particularly true where dull weather and consequent slow regrowth is a characteristic of the climate.

xi. In these trials no provision was made for the strategic energy supplementation of at least some animals while grazing. At this point it is of interest to consider the grades attained by the animals marketed directly from the pasture. From a group of 26 animals

11% dressed out in the Super Grade,
46% dressed out in the Prime A grade,
23% dressed out in Grade 1 A, and
19% dressed out in Grade 2.

Some form of Supplementation at a modest level could have resulted in the improved finishing and grading of the poorer quality animals.

Having established the importance of improved pastures for beef cattle feeding programs, the principal problems which now arise are the decisions which must be made for the practical implementation of the correct intensification strategies. Because of the tremendous topographical, climatic and soil variation which occur in the higher rainfall areas of Natal, it is almost impossible to set a standard procedure for pasture intensification. However, certain principles which can be used as guidelines in developing planned and integrated production programs can be given.

## Conclusions

An analysis of the available data has shown that many of the problems facing the beef industry in the Eastern High Rainfall area can be overcome by the strategic and planned replacement of the veld with improved pastures. The following conclusions can be drawn from the available data.

1. Improved pastures can bring about a highly significant increase in the weaned calf mass per unit area. This is due to an increase in both the carrying capacity and the A D G of the calves.

2. Improved animal performances are coupled with highly significant increases in the marginal returns per hectare. Increases in animal performance are adequate but depend upon the class of pasture used.

3. It is clear that intensification for cow herds should be limited to low cost pastures without necessarily resorting to capital intensive pastures.

4. The same general conclusions can be drawn regarding the growing out of steers. There is however, a good case for the strategic use of intensive high cost pastures, particularly if these are combined with the conservation of forage.

5. Low cost legume based pastures in meeting the demands for good quality stock and that stock grazing these pastures can attain acceptable mass and grade. However, the data suggests that there is a need for the strategic supplementation of animals grazing legume based pastures with additional energy.

   Such supplementation will

   * finish animals for the most remunerative markets;

   * enable animals which are younger or which have not done as well to reach marketable standard at an early age.

6. The alternative to efficient supplementation and to feedlot finishing is to carry animals through a second winter and to market them off grass between the ages of 28 to 30 months.

7. The efficiency with which beef can be produced off pastures is dependent on the following factors.

   i. If an abundance of low cost pasture can be generated, attention should be paid to the time of calving and the calving period.

   ii. Potentials should be matched and optimized. Only good quality cattle which have the ability to efficiently utilize good quality roughage justify the production of high quality pastures.

   iii. Wintering of livestock is the most expensive portion of the production program and for this reason should be reduced to a minimum by

* the use of crop and pasture residues to maximum advantage;

* managing pastures for late season production (foggage) thus reducing winter requirements; and

* the development of suitable cheap short duration pastures.

8. Probably the most important problem which arises in the development of a pasture program is the financing of the project. Practical and large scale demonstrations have shown that low cost pastures with a moderate to high production potential can easily be generated to meet specific requirements. Such pastures can be used for the short term growing out of animals which have the ability to respond.


## Acknowledgements

The authors wish to acknowledge with grateful thanks the helpful assistance of Mr J.K. Arnott in assembling the data and the useful criticism of the paper and that of Mr B. Mappledoram who was responsible for the care of the field experiments reported in this paper.


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