THE ECONOMICS OF FERTILIZER USAGE IN CULTIVATED PASTURES

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In recent times livestock farmers in the higher rainfall areas of Natal have been faced with increasingly greater production problems. Of these, the most important and those most commonly quoted are as follows.

- Overheads and other fixed costs are high and contribute considerably to reduced profit margins.
- The prices obtained for livestock products are low relative to the high costs of production.
- The cost of roughage production is high due largely to the rapidly increasing cost of fuel and fertilizer.

As a result of these difficulties farmers are enquiring whether or not the high costs of forage production can be economically justified. With a view to obtaining objective data certain farming operations and pasture production systems are being constantly monitored to establish and maintain reliable production norms and costs. At the same time large scale production experiments have been initiated and are regularly evaluated in terms of their output relative to costs.

One of these experiments is that in which the cost of maintaining beef yearlings on well established Kikuyu pastures fertilized with nitrogen at different levels is being examined in detail. The essential features of this experiment are as follows.

- The four treatments (= 4 levels of nitrogen application) are 112, 224, 336 and 448 kg N per hectare applied as LAN in three equal dressings over the course of the season.
- Phosphate and potassium were applied uniformly to elevate soil levels to 15 and 150 ppm respectively.
- Each treatment was stocked with a similar group of yearling oxen which were rotated on a weekly basis over the four paddocks of each treatment.
- An even stocking pressure was maintained by using a "put and take" system.
- All animals had free access to a phosphate/salt lick.
- Half the animals on each treatment were treated with Ralgro implants.

The more important results obtained over a 160 day grazing period during the 1979/80 season are presented in Table 1.

The essential features of the data presented in Table 1 are as follows.

1. The cost of the nitrogen which is the most important single factor contributing to the productivity of intensively managed Kikuyu pastures is a relatively small fraction of the total costs involved in raising livestock. At the optimum level of nitrogen fertilization (ca. 336 kg N/ha/annum) the cost of nitrogen is only about 13% of the total production cost.

2. The data indicate that under the prevailing conditions, the optimum stocking rate of a well fertilized Kikuyu pasture is about 11 steers per ha. It is probable that the real value is higher because the period under consideration coincided with a period when exceptionally hot and dry conditions were experienced. During the period October 1979 to March 1980 only

TABLE 1 The production potential of highly fertilized Kikuyu pastures when grazed with yearling steers

N Level Applied	(1) Pasture Costs	(2) Animal Costs	Total Costs	N as % of Total Costs	Stocking Rate	(3) Total Livemass Gain	(4) Marginal Return		(5) Cost/kg Livemass Gain	Return to Total Cost
(kg/ha)	(R/ha)	(R/ha)	(R/ha)	(%)	(Steers per ha)	(kg/ha)	(R/ha)	(R per steer)	(cents)	(%)
112	150	822	972	8,1	6	672	149	24,84	22,3	15,3
224	238	1 097	1 335	11,8	8	896	162	20,21	26,6	12,1
336	326	1 508	1 834	12,8	11	1 232	223	20,28	26,5	12,2
448	413	1 645	2 058	15,2	12	1 344	186	15,48	39,7	9,0

(1) Includes establishment, top dressings and fencing costs and interest at 12% per annum but excludes fixed costs.
(2) Includes purchase costs (60c/kg), lick, vet and labour costs and interest at 12% per annum.
(3) A D G = 0,7 kg which represents the mean value over all treatments for this period.
(4) Mortality losses @ 1% .
(5) Estimates based on total pasture costs.

614 mm of rainfall was measured which is low when compared with the average precipitation of 877 mm over this period.

3. It is of considerable interest that satisfactory financial returns can be anticipated from an intensive stocker operation in which costs have been liberally estimated and returns are conservatively estimated. The data suggested that when capital and finance charges are excluded the margins, which may be anticipated, are about R220/ha and R20/steer under the conditions of the experiment.

4. At the optimum stocking rate the cost of production is estimated at 27 cents per kilogram of livemass gain. It is of interest to compare this value with abattoir prices of 120 to 130 cents per kilogram for Grade 1 animals at the time under consideration.

5. An important consideration which has not been taken into account in the above analysis is the grazing value of the pasture residues. Research has indicated that Kikuyu foggage (when supplemented with a protein supplement) will satisfactorily overwinter a weaner calf. Using the results from previous research it is estimated that the foggage value of the Kukuyu residue is abour R85/ha.

In a similar experiment conducted at the Stock Owners Experimental Farm at Tweedie the relative productivity of Kikuyu and K11 (= Coastcross II Bermuda grass) when fertilized uniformly with 336 kg N (as LAN) per ha were compared at two different stocking rates. The results obtained over a 126 day grazing period are as given in Table 2.

The results from the data presented in Table 2 indicate the following.

1. When adequately fertilized there is not much difference between the two grasses in their overall productivity.

2. The carrying capacity of Kikuyu is marginally higher than that of K11 but the performance of stock grazing K11 is greater than that of thos grazing Kikuyu.

3. The importance of stocking well fertilized pastures to capacity in order to exploit their potential is clearly indicated by the differences in livemass gain. These differences manifest themselves significantly when production costs are calculated. The data show that costs are reduced at the higher stocking rates.

4. The economic feasibility of using well fertilized grass pastures in a beef stocker operation is adequately demonstrated, even under relatively poor climatic conditions.

Having established that using well fertilized grass pastures to grow out beef yearlings is economically feasibile, it is now opportune to consider ways and means whereby the profitability of such an operation can be further improved. Probably the first and most important consideration is the use of Ralgro. Research results at Tweedie over several years have now clearly indicated that the use of Ralgro can be relied upon to improve the performance of individual animals by between 10 and 15% . The use of this implant is, therefore, recommended whenever growing cattle are grazed on planted pastures.

An important aspect when considering the utilisation of highly fertilized pastures is the choice of the animals used. This aspect is at present, being examined in a large scale grazing experiment but, as yet, it is still too early to provide reliably quantified data. The indications are that it is important that animals which have the potential to exploit the quantity and the quality of the available forage should be selected.

In recent times many graziers have considered and enquired regarding the energy supplementation of animals grazing on pasture. Various systems and levels of supplementation have recently been evaluated and the results obtained have

TABLE 2 The production potential of Kikuyu and K11 pastures when grazed with yearling steers at different stocking rates

Treatment	Steer Grazing Day per Hectare	Mean Daily Stocking Rate	A D G	Total Livemass Gain	Production Costs (c) per kg Livemass Gain	Production Costs (c) per Steer per day
		(steers/ha)	(kg)	(kg/ha)		
Kikuyu -- high Stocking Rate	1 412	11,2	0,73	1 034	29	21
— low Stocking Rate	1 090	8,7	0,80	823	36	28
K11 — high Stocking Rate	1 365	10,8	0,86	1 009	30	22
— low Stocking Rate	1 074	8,5	1,07	780	38	28
Mean	1 235	9,8	0,87	912	33	25

TABLE 3 The productivity of an Ariki/clover pasture when grazed by sheep

Variable	Sheep	MLU
Total Production (grazing days/ha/annum)	4 962	827
Total Costs @ R206/ha/annum (cents per grazing days)	4,15	24,9
Cost of Fertilizer (cents/grazing days)	1,45	8,7
Fertilizer (% of total cost)	35%	35%

clearly indicated that while animals do show some response to energy supplementation there is, in fact, no financial justification. For this reason, it is recommended that pastures should only be used to grow out animals and in so doing to reduce the feeding phase as much as possible.

The use of a phosphate lick on pastures fertilized with phosphatic fertilizer has been questioned and is now being examined at Tweedie. As yet the results are inconclusive and require further research before reliable recommendations can be made.

TABLE 4 Production/efficiency factors for a selected Natal dairy farm (1979)

PRODUCTION FACTORS			
Average number of cows milked	–	162	
Average daily milk production	–	2 512	litres
Total milk production	–	917 009	litres
Area of pasture	–	162	hectares
Value of fertilizer used	–	R17 810	(= 9,7% of gross milk income)
Value of diesoline used	–	R 1 204	(= 6,6% of gross milk income)
Concentrates fed	–	242	tonnes
EFFICIENCY FACTORS			
Rate of concentrate feeding	–	0,252	kg per litre
Cost of concentrates	–	3,00	cents per litre
Cost of diesoline	–	1,31	cents per litre
Ratio of diesoline used to milk produced	–	1:24,4	
Cost of fertilizer	–	1,95	cents per litre
Relative cost of fertilizer	–	R1100	per hectare of pasture
Change in milk production, 1978 vs 1979	–	+ 63 912	litres
Change in diesoline used, 1978 vs 1979	–	– 4 014	litres

The results of various economically orientated analyses have indicated that mutton sheep production is a relatively more profitable enterprise than beef production. Study group data (Dept Ag Econ., 1979) show that in East Griqualand, on the average, the gross margin derived from cattle farming is R38/mlu while that derived from mutton/wool sheep is R93/mlu. As yet the relative profitability of fat lamb production from cultivated pastures has not been adequately evaluated. The only recent work on the subject is that of Brockett (1979), who reported on the use of pure clover pastures for growing out lambs. For this reason, certain specifically developed and managed pastures have been monitored and the results clearly indicate that if such factors as species selection, grazing management, forage utilisation techniques and proper fertilisation are adequately attended to then cultivated pastures are financially rewarding for fat lamb production. This is particularly the case when the importance of having available ample high quality autumn/winter grazing for lambing ewes and growing lambs is taken into account. To provide some information on the potential of pastures for fat lamb production, 12 ha of an Ariki ryegrass/clover pasture in the Natal Midlands has been closely monitored during the past season and a summary of the data obtained is presented in Table 3.

Although the data from this trial have not been adequately analysed economically, it is again abundantly clear that not only has the pasture provided a cheap source of quality roughage at a critical time but that the cost of fertilizer is only a relatively small fraction of the total costs. The economics of using planted pastures for milk production is well known and it is generally accepted that the most profitable manner by which milk can be produced is by utilising pastures effectively. During the past year a well run Natal dairy farm has been carefully monitored and the results obtained are presented in Table 4.

The efficiency factors given in Table 4 clearly indicate the rôle of planted pastures and the low cost of fertilizer relative to the costs of other production factors. Relative to earnings, fertilizer and diesoline costs were 9,7% and 6,6% respectively, thus indicating that in a well planned and rationalised forage production programme one of the most important production factors, namely fertilizer, is not necessarily the high cost factor it is generally believed to be.

Looking to the future it is clear that the rationalised and planned use of fertilizer for pasture production will become increasingly more important. The fundamental reason for this is that greater production will be expected from a smaller area of available land. If this is to be achieved then some of the more important problems that will require attention are as follows.

As yet the relationships between soils, planted pastures and specific fertilizer requirements are not always as clearly understood as they should be if production is to be increased at reduced costs. In this regard there is a serious lack of knowledge regarding the fertilizer requirements of pastures grown on those soils/sites which are either marginal or not

suitable for cash cropping. Because these soils will become increasingly important for intensified pasture and animal production in the future it is important that their potentials and limitations are clearly understood.

In order to further justify the use of intensive pastures in the future it will become increasingly necessary to pay attention to the following aspects of forage crop production.

- Sodseeding pastures with a view to double cropping and so further exploiting existing resources (soil fertility and moisture) will become increasingly important. As an example, on some Natal farms fortifying existing pastures with strategic crops such as rape and turnips is an acceptable and on going procedure.

- In order to assist in reducing the cost/price squeeze in the summer rainfall area it will become increasingly important to exploit differences in elevation with a view to providing cheap irrigation water. This will not only reduce the requirements for conserved forage but will also improve upon the efficiency with which the available resources (land, available soil fertility and crop growth potential) are economically exploited.

- It will become increasingly important for consultants/advisers to plan production programmes and develop forage cropping schedules for strategic and specific purposes and to take into account the specific requirements of planned marketing programmes. As an example, large areas of veld which have been fertilized and fortified with improved grasses and legumes are now only strategically fertilized in the mid autumn and late winter with the object of meeting winter and spring shortfalls of grazeable roughage without increasing mid summer surpluses. By this technique, livestock production has largely been rationalised through avoiding summer surpluses, reducing on the heavy expenditure incurred when conserving forage in a difficult climate and by providing an abundance of high quality roughage for winter consumption.

- Probably one of the most important emerging problems is planning livestock production and marketing programmes with a view to exploiting favourable seasonal price differentials and avoiding high cost situations. In doing so, attention will have to be given to the economic development production and utilisation of forage crops and crop residues to meet specific production requirements. This aspect of farm, forage/stock and cash flow planning is still very much in its infancy and requires the combined attention of agronomists, economists and accountants in order to develop systems of production which are economically and ecologically balanced.

Looking to the future, it is felt that only by paying attention to these details will it be possible to effectively and economically contain relatively high cost inputs such as fuel and fertilizer in an animal/forage crop economy.

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