THE ROLE OF FERTILIZED PASTURES IN THE ECONOMICS OF THE LIVESTOCK INDUSTRY IN SOUTH AFRICA

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Over the years, increasing attention has been drawn, by animal scientists in particular, and agriculturalists in general to the potential shortfall in national supply of livestock products (Harwin & Lombard 1974, Luitingh 1974). Since it is generally considered that the demand for grain for human consumption will mitigate against grain-fed livestock in future, and since there is a decreasing amount of natural veld available for grazing, it has been suggested that development of improved planted pastures is the only means for increasing the livestock population in South Africa (Harwin 1974, Luitingh 1974, Theron 1975, Theron & Harwin 1976).

Undoubtedly the area of South Africa suitable for pastures is great (Luitingh 1975) and the increased livestock productivity which can be expected from such pastures is high. Yet, the area planted to pastures in South Africa has apparently not increased markedly.

As Luitingh (1974) states, "It is an unfortunate fact that research findings fail to find application in practice. This may be due to many factors, but often the importance of such findings are not or may not be applicable at the time and are subsequently hardly ever reconsidered in the light of changing conditions".

The purpose of this paper is to examine one set of these factors viz the economic factors concerning the utilization of pastures in South Africa. Whereas much research has been conducted on the establishment of suitable grass species, physiological characteristics of such grasses, their response to fertilization and latterly their usefulness for the grazing animal, little attention has been devoted to economic considerations.

The task of determining the "economics of pasture production" is not a simple one. The alternatives are either

1 to present a simple book-keeping account of costed pasture experiments or

2 to attempt a fuller analysis of the economic role of pastures in various farming systems.

Where attempts have been made to cost pasture utilization in South Africa these have usually been accounting exercises based on short periods of the year, partial pasture use and other incomplete systems which do not in fact provide a clear picture of pasture economics. It would appear that no real attempt has been made to determine

a the economic role of pasture in a whole farming system or

b the principles involved in attaining maximum productivity and returns from pastures.

This is not surprising because pastures are intermediate products in the true sense of the word, since they utilize sunlight energy, minerals and moisture for the production of nutrients assimilable by livestock for the production of milk, meat and fibre products.

Consequently pastures do not generally produce income in and of themselves, but only through the livestock which utilize them. The manner in which the pasture is utilized (grazing husbandry), the class of stock kept on the pastures, and indeed the level of animal husbandry are all technical aspects of pastures. Additionally planted pastures produce essentially the same nutrients as 'free' veld and other crops — differing only in degree of quality and quantity per hectare. Thus to unravel the complex interrelationship that encompasses the economics of pasture production it is necessary to

a determine the biological factor/product relationship (grass/animal)

b determine the biological factor/factor relationship that exists between different forms of fodder in the production of livestock nutrients

c superimpose price relationships on a and b above.

In short there are infinitely more variables and interactions in a pasture/grass/economic system than in the traditionally notorious biological experiment. Working closely with a pasture research development team and assisting farmers to plan integrated pasture development programmes over the past two years has afforded the opportunity of becoming better acquainted with factors governing the economics of pasture utilization.

This can by no means be considered to be a definitive treatise on the subject, limited as it is by insufficient data on the complex variables and interactions involved. Rather it is an attempt to document some of the factors which have been found to be important in making pasture pay. Broadly these are

1 the livestock product : fertilizer price ratios
2 the class of stock kept on pastures
3 the method of pasture utilization and
4 the percentage of the farm planted to pasture.

Livestock : fertilizer price ratios

The indices of livestock products and fertilizer prices over the past 18 years are presented in Table 1.

Despite the recent dramatic increases in fertilizer prices, increased livestock prices have tended to keep the ratios in favour of livestock for the latter half of this period. From these data it may be concluded that recent price changes have not in fact changed the potential profitability of pastures. This does not imply that pastures have been profitable under all circumstances but merely that relative prices have been reasonably constant.

Nevertheless legume/grass pastures with reduced external nitrogen requirements must inevitably show a better cash-flow and profit position than wholly grass pastures dependent upon purchased nitrogen.

Class of stock

Dairy and Fat lamb

Of the three major ruminant enterprises which may be produced on pasture, milk and fat lamb are most likely to be profitable because of favourable absolute prices and relative efficiency of feed conversion. In fact the wide use of pastures by dairy farmers would tend to support this claim. Surprisingly, however there is no published research data in South Africa upon which positive economic evaluation of either dairy or sheep on pasture can be based.

TABLE 1 South African price indices' fertilizer, beef, sheep and milk

Year	Fertilizer	Beef	Sheep	Fresh milk
1957/ 58	104,2			
59	101,6	98,5	98,4	99,4
60	96,9	100,8	98,6	100,3
61	95,9	100,7	103	100,3
62	97,2	99,6	95,6	100,3
63	97,2	105,5	108,8	96,7
64	100,4	106,3	120,3	97,5
65	97,8	136,3	120,9	106,5
66	102,1	142,7	115,0	113,2
67	101,0	154,4	127,7	120,9
68	101,4	173,6	123,8	120,9
69	100,3	173,8	118,3	120,9
70	100,3	165,7	124,7	120,9
71	103,1	181,3	128	129,5
72	109,8	182,9	158,2	138,3
73	116,3	242,6	228,6	146,3
74	129,0	322,1	263,7	171,3
75	208,7	352,8	279,1	225,5
76	204,3	341,8	297,6	270,9

1 Source: Abst Agric Stat 1958/59 — 1960/61 =100
2 As at July 1 annually

Conservative estimates of the nutrients that can be supplied by summer Kikuyu and irrigated winter ryegrass pastures indicate that pastures can provide sufficient protein for maintenance plus 11 litres per cow per day, and sufficient energy for maintenance plus six litres per cow per day. Thus it can be expected that with minimal energy supplementation, pastures can adequately provide the nutrient requirements for the above-average South African dairy herd. Whether it would be economically wise to pursue a pasture-based dairy policy would be dependent upon the pasture costs per day and this in turn is governed by the broad principles to be discussed under the heading, pasture utilization.

Beef

Beef production must be considered in two phases viz the cow herd producing weaners and the weaner to slaughter, or finisher phase.

In a review of the available published literature on 'grass-feedlots'* Parsons & Penderis (1976) found that with few exceptions the return per hectare is superior on grass-feedlots to maize feedlots and that the exceptions occurred where the carrying capacity on pasture was low and/or energy supplementation was not provided.

Beef cows on pasture

Carrying capacity can be increased between 4 and 6-fold on planted pastures relative to natural veld (Murray 1974, Harwin & Theron 1975, Hyam, Penderis, Coetzee & Pitout 1975, Theron 1975, Theron & Harwin 1976). Although it has been shown that such increases result in a gross income which exceeds costs (Theron & Harwin 1976), whole farm budgets and computer simulator models (Lubbe & Parsons 1977) indicate that invariably the beef cow on pasture has the lowest priority in developmental planning because beef cow gross margins are relatively low. The reasons for this can possibly be ascribed to the relative inefficient feed conversion, long gestation period and low productivity of the beef cow.

* viz: The finishing of beef on pasture — often with an energy supplementation of 3 to 5 kg maize meal per head per day.

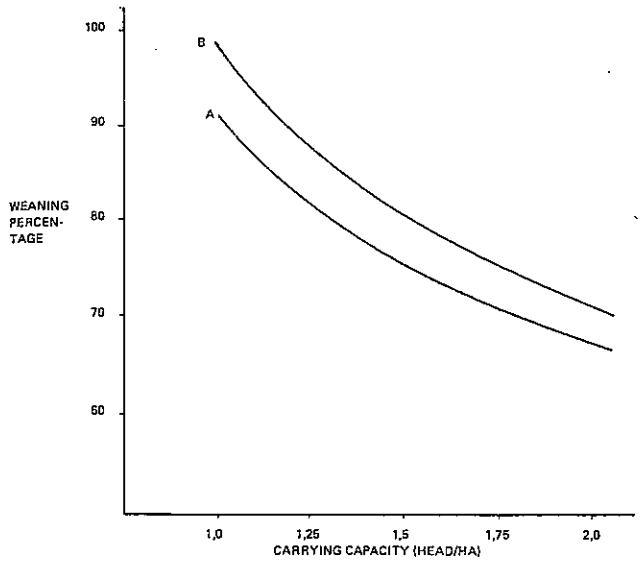

FIG. 1 Minimum performance required on C. ciliaris to break even with veld stocked at two levels:

A) 0,167 head/ha
B) 0,33 head/ha
where C = 0,17, Pc = 200, VC (veld) = R10, VC (pasture) = R17,20, I = R20, R = 0,2, Pr = 175, FC = 35,8, Pw = 90, W (veld) = 0,80 (see text for interpretation).

The development of a formula

$$W^* = (GM - (Ic.\,Pc - VC - I - R.\,Pr - \frac{FC}{H})\,H)\,(P2^{-1}\,H^{-1})$$

*Where W = weaning rate
GM = desired gross margin
C = cull rate
Pc = price of cull cows
VC = variable costs (labour, vet, hay, supplements)
I = interest costs per cow per annum
R = replacement rate
Pr = price of replacement heifer
FC = fixed pasture costs (fertilizer, irrigation)
H = carrying capacity in head/ha
PW = price of weaner
or PW = M. Pm
M = weaner livemass
Pm = price/kg livemass

To determine the weaning rate required on pasture to break even with the net returns expected on veld, has been useful in indicating whether beef cows on pasture will be profitable or not. An example of the application of this formula is shown in Figure 1.

A comparison of the results from Figure 1 and experimental as well as commercial farm practices suggest that weaner production on pasture cannot be expected to compete economically with that on veld while pasture stocking rates remain as low as they have been to date. Preliminary evidence from one or two farms where short duration grazing methods are being employed to increase carrying capacities on pasture are encouraging. The evidence would suggest that the carrying capacity on pastures has been underestimated in many experimental as well as farm situations resulting inevitably in only marginal profits.

Pasture utilization

There are two distinct biological aspects to pasture utilization which are in fact opposite sides of the same coin. These are the physiology of grass growth on the one hand and animal nutrition and animal stress on the other.

Very briefly, for maximum production of grass per hectare it is necessary to ensure that adequate reserves exist in the plant for rapid regrowth after defoliation. Hence it is essential that grass is neither defoliated completely nor too frequently. For the animal it is necessary to ensure a constant supply of adequate nutrients for the entire year. When there is a total lack of grazeable material for part of the year, the provision of conserved hay or silage is expensive and detracts greatly from profits. Both the grass and animal requirements are met, in as far as it is possible, through rotational grazing. Rotational grazing techniques have been used in Europe for decades to achieve these ends (Voison 1959), and have been practised to a limited extent in veld management of farms in Southern Africa for many years. However it is only recently that research has been undertaken in South Africa on this most crucial aspect of grass management. Tainton, Booysen & Nash (1977) have shown that dry matter production of veld can be increased with improvement in grazing rotation and Rethman (1977) has found that the grazing season of pasture can be lengthened through rotational as opposed to continuous grazing.

Practical experience has shown that rotational grazing can indeed double carrying capacity on veld relative to less developed grazing methods. It would be expected that similar increases can certainly be achieved on some species of planted pastures; particularly those with a bunch growth habit.

Since pasture is an intermediate product with a relatively high fixed cost (establishment, fertilization and irrigation) its economic viability is entirely dependent upon the output of livestock and hence upon the manner in which the pasture is utilized. High carrying capacities are most im-

portant in ensuring maximum returns to scarce and/or expensive pastures because the fixed costs are spread over greater production in the form of meat or milk thus reducing per unit costs. In fact it would not be inaccurate to say that carrying capacity is the single most important technical economic factor influencing pasture utilization. Booysen, Tainton & Foran (1975) have discussed the theoretical relationships which exist between returns per hectare and returns per livestock unit. Unfortunately limited data exists on which to base field recommendations for different pasture species, fertilizer levels and climatic conditions, but from work reviewed by Parsons & Penderis (1976) it would appear that an optimum relationship exists between carrying capacity and fertilization rate per hectare. For grass feedlots this would appear to average out at approximately 30 kg nitrogen per head per growing season.

The role of pasture in farm systems

From the above discussion it is apparent that

a the inclusion of pastures in farming systems to increase profitability involves a complex set of biological and economic relationships and

b that the economically-important biological norms and coefficients required for this task have been poorly researched and are largely inadequate for the purpose.

Nevertheless farm advisory services cannot afford to wait for research to catch up with its requirements.

Despite the shortcomings of research and research procedures, intuition and deductive logic can be employed to incorporate pastures into the farm programme profitably. Generally the product to be produced on any given farm (beef, milk, lamb) is a function of the market, farmer preference and financial constraints and is consequently independent of pasture development. Rather, pasture development is a function of the product to be produced.

Using beef ranching as an example the procedure would be to

1 ensure adequacy of animal husbandry;

2 establish the most profitable marketing strategy, particularly the age and grade at which beef should be marketed;

3 ensure maximum utilization of veld resources through rotational grazing;

4 if greater intensification is desired and if managerial and financial resources permit, establish only sufficient pasture for the enterprise which would give greatest returns per hectare; viz a grass feedlot for finishing weaner cattle for market in this case,

(current estimates indicate that three to five percent of the total farm area would be required for this purpose and that in general farm profits could be increased by some 50 to 70 per cent over weaner production on a wholly veld-based system);

5 establish more pasture for utilization by the beef cow herd, as an additional step on very small farms, where the land available is more limiting than either managerial or financial resources.

If I have disappointed by providing no pasture recipe and no precise figures on profit to be expected from pasture, I make no apology for this shortcoming because it should be apparent that pastures cannot simply be slotted into farming systems without due consideration of the many factors discussed above.

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