ESTIMATED PROFITABILITY OF INVESTMENT IN LEGUME PASTURE DEVELOPMENT IN FAR NORTH QUEENSLAND

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ABSTRACT

Economic guidelines for legume pasture development at four localities in the Cape York area of Queensland are provided. Based on "best estimates" of the main parameters it was concluded that development would only be profitable at the centre closest to Cairns. Profitability was found to be most sensitive to variations in beef prices. It was calculated that a 25% reduction in the fertiliser requirement of the legume would extend the "zone of profitability" a further 150 road km from Cairns. Government intervention, desirable because of Australia's comparative advantage in the extensive pastoral industries, in the form of beef roads was likely to extend this zone to cover virtually the whole of the Cape.

INTRODUCTION

For more than a decade now both the Queensland Department of Primary Industries and the C.S.I.R.O. have undertaken major research programmes aimed at assessing the role of Townsville stylo (*Stylosanthes humilis*) in the pastoral environment of North Queensland. However, the level of private investment in Townsville stylo development does not seem commensurate with this public investment in research. While a number of other reasons have been advanced to explain the slow adoption of Townsville stylo development by the grazing industry, we feel that a lack of economic data has contributed to this. The provision of simple economic guidelines based on early experimental results could stimulate innovative graziers to test the new technology in commercial situations.

Guidelines of this nature for large scale development of properties based on Townsville stylo pastures with basic herd sizes of 3,000 head have been provided by McLintock (1970) for the Northern Territory situation. The profitability of incorporating areas of the pasture into existing properties in the Townsville-Ayr region of North Queensland has been examined by Robinson and Winks (1970) and Robinson (1971).

In this paper our aim is to provide estimates of profitability of Townsville stylo development in some of the areas in Northern Australia designated by Begg (1972) as suitable on the basis of climatic, edaphic and topographic factors. In addition, we examine the effect that one type of government action (beef roads) might have on the economics of pasture development. Subsequently, the declining importance of Townsville stylo and the increasing importance of other species are discussed. On the assumption that the former will only be discarded if more productive legumes are available, this economic assessment should be regarded as providing information on the wider question of the profitability of legume pasture development generally in far north Queensland.

THE LOCALITIES EXAMINED

Of the 40 million hectares estimated by Begg as suitable for Townsville stylo, the two largest homogenous areas exist in the Northern Territory running up into the top end and in Cape York Peninsula (Figure 1). The four centres selected in the Cape York area, viz. Abingdon Downs, Highbury, Strathburn and Merluna, have suitable country for Townsville stylo development in relatively close proximity and allow a range of profitability estimates to be made that should cover most situations in the Peninsula.

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However, no attempt is being made to provide commercially reliable estimates for properties in these localities, nor is it suggested that there is necessarily any motivation or willingness on behalf of the particular properties chosen to undertake the developments analysed. These centres are located as follows in relation to Cairns which is both a receiving centre for cattle and a distribution point for fertiliser used on the pasture.

Centre	Distance from Cairns (km)
Abingdon Downs	547
Highbury	419
Strathburn	580
Merluna	708

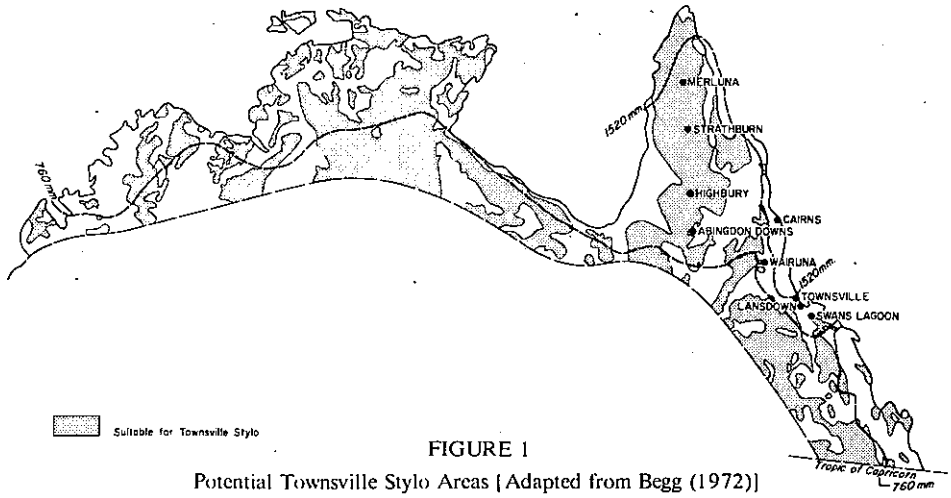

FIGURE 1

Potential Townsville Stylo Areas [Adapted from Begg (1972)]

ASSUMED LEVELS OF PRODUCTIVITY

With only limited animal productivity data available from one of the four localities, we have adopted productivity equivalent to that obtained at the "Swans Lagoon" research station in the Townsville region. In terms of rainfall and evapotranspiration these localities are broadly similar to "Swans Lagoon", although information presented by Fitzpatrick and Nix (1970) gives some general grounds for believing that the two northern-most localities would be more productive. Native grass types in the Cape are also broadly similar to those around "Swans Lagoon". In all localities eastern mid-height, tussock-type perennials are dominant with *Heteropogon contortus* and *Themeda australis* often occurring. Moore's (1970) classification includes these localities in the "tropical tall grass" grazing lands. Notwithstanding the broad similarity of these environments it is clear that this economic assessment must be regarded as a conditional one until productivity data for the different localities become available.

Grazing trials at "Swans Lagoon" (Winks and Lamberth 1966) have indicated that fertilised Townsville stylo pastures stocked at 1 beast to 2.4 ha can fatten cattle in one season — typically December to August — with starting weights of say 284 kg and final weights of approx. 455 kg. Whilst cattle have been run on Townsville stylo pastures at isolated locations in the Cape (eg. Merluna and Abingdon Downs) and trials have been conducted at several other centres (Kalinga, Koolburra, etc.), there is little information available on weight gains. A trial at Wrotham Park, 90 km from

Highbury, has, however, yielded some valuable data. In a comparison of 18-month-old steers on Caribbean stylo (*Stylosanthes hamata* cv. Veranno) — Sabi grass pastures and Townsville stylo — Sabi grass pastures weight gains of 150 kg and 130 kg respectively were obtained in the first year (Anon 1973) at a stocking rate of 1 beast to 1.3 ha. These gains are below the level of 170 kg adopted in this analysis, but it is assumed that at the adopted stocking rate of 1 beast to 2.4 ha a weight gain of 170 kg would be achieved.

To estimate initial productivity we have adopted two levels of stocking rates of native pasture — 1 beast to 8.1 ha and 1 beast to 16.2 ha. The higher stocking rate is, in our opinion, the most intensive level likely to be achieved over much of the Cape by the introduction of additional fences and watering points. Thus, productivity increases which accrue beyond that level can be regarded as resulting solely from the introduction of the legume. The lower stocking rate would more closely resemble current rates on country with minimal improvements and in fact may be greater than that actually existing on many properties. In this latter situation, the productivity increases accrue to the development "package" which consists of fencing, watering points and the pasture itself.

Again there is a dearth of information for weight gains on native pasture. Trial results from Wairuna (Mawson 1956) and Swans Lagoon (Winks and Lamberth 1966) have been used as guidelines. In respect to both climate and pasture type Wairuna, like Swans Lagoon, is broadly similar to the peninsula localities. Using these data it has been estimated that the average liveweight of stores would be 227 kg and 295 kg at 2 and 3 years of age respectively. The provision of Townsville stylo pastures would enable graziers to fatten the 3 years old stores for sale in July-August instead of turning them off as store stock in January-February.

ECONOMIC ANALYSIS

The development proposal

For each of the four localities analyses are based on existing breeding and store production enterprises with areas suitable for the introduction of Townsville stylo pastures. The development unit adopted is a 1,000 ha block. Since there are economies associated with introducing substantial areas of pasture (sharing of watering facilities, fences etc.) it has been assumed that more than one of these would be developed. Establishment of the pasture is by aerial seeding after burning the existing native pasture. Initial superphosphate application would be 252 kg ha^{-1} and maintenance applications the same applied biennially. Other capital expenditure consists of the provision of an airstrip, fencing and a watering point.

Data used in the derivation of estimated capital expenditure (Table 1) were generally obtained from commercial situations in the Peninsula (Sclip unpublished data) with appropriate adjustment to take account of inflating money values. The B.A.E. price index (1973) was used in adjusting this data. General road transport rates (operative in 1974) for Abingdon, Highbury and Strathburn are approximately 3 c $tonne^{-1}km^{-1}$ but for Merluna rates of about 8.5 c $tonne^{-1}km^{-1}$ apply because road conditions deteriorate markedly north of Musgrave. However, uniform rates of 3 c $tonne^{-1}km^{-1}$ were adopted in this paper because we feel it is unlikely that these poor road conditions will continued for many more years. Estimated capital expenditure is then very similar in magnitude for all centres.

Cost levels prevailing during the period 1971-72 were adopted. However, for fertiliser, prices existing in November 1974 were used. This was done because we believe that the latter will prove to be closer to those prevailing in the future, relative to other costs, than those existing in 1971-72. An examination of the relative movement of indices of farm input prices generally and superphosphate in particular, revealed that increases over 1971-72 to 1974 were 66% and 97% respectively. The international supply position of rock phosphate, escalating processing costs and the level of any future

TABLE 1

Expenditure on developing 1 000 ha block ($)

Expenditure item	Abingdon	Highbury	Strathburn	Merluna
Seed 3 kg ha^{-1} at \$1.10 kg^{-1}	3,300	3,300	3,300	3,300
Fertiliser 252 kg ha^{-1}, bulk superphosphate at \$41.20 t^{-1}				
. at Cairns	10,382	10,382	10,382	10,382
. freight	4,284	3,276	4,536	5,544
. aerial application	3,276	3,276	3,276	3,276
Fencing 11.3 km at \$250 km^{-1}	2,825	2,825	2,825	2,825
Watering Point				
. windmill, pump, piping, troughs etc.	3,500	3,500	3,500	3,500
Airstrip	600	600	600	600
TOTAL	28,167	27,159	28,419	29,427

bounty are some of the major uncertainties likely to affect fertiliser price levels. The development of rock phosphate deposits in the Duchess region of N.W. Queensland could place North Queensland in a favourable position compared with other areas.

Analytical approach

As the development consists of improvement of part of an existing property we will restrict ourselves to a partial development analysis. This will indicate whether the investment is likely to be profitable. If estimated profitability appears quite attractive this partial analysis could be followed by a "whole farm" approach as used by Robinson (1971) in an earlier analysis of the Townsville region.

Methodology used in the appraisal is the standard investment analysis approach of identifying and valuing both benefits and costs and discounting those occurring in the future so that comparisons can be made and rates of return calculated. Planning horizons of 10 and 20 years have been assumed. The latter would probably represent the maximum likely to be adopted by graziers whilst the former is supportable on the grounds of uncertainty associated with the technology. To simplify the analysis, the effect of income tax has not been incorporated. With the recent losses of many income tax benefits (deduction of capital expenditures, etc.) omission of the effect of income tax means that profitability will be overstated.

Extra returns from 1,000 ha block

In estimating additional returns deriving from the pasture, store and slaughter animals were valued at average prices prevailing in Mareeba over the years 1971-72. Our view is that prices in this period are likely to be closer to future levels than those prevailing in 1973-74. It was calculated that the increase in returns would be \$20,058 p.a. compared with native pasture stocked at 1/8.1 ha and \$21,278 p.a. compared with native pasture stocked at 1/16.2 ha.

Extra costs associated with increasing production

The major recurring expenditure associated with the development would be the biennial application of superphosphate. Other additional costs would be animal health (dipping, etc.), freight and repairs and maintenance. It was also assumed that there would be insufficient "unused capacity" in the existing property work force to handle

the extra stock and that extra casual labour of 1 labour unit for 3 months would be required. Details of recurring expenditure are shown in Table 2. While the fertiliser would be applied biennially an annual cost is presented. This simplifies the matching of annual inflows (returns) and outflows (costs) when discounting to obtain an internal rate of return on the capital invested.

TABLE 2

Estimated additional annual costs for 1 000 ha block

Item	Annual Cost ($)			
	Abingdon	Highbury	Strathburn	Merluna
Increase Over N.P. at 1/8.1 ha				
Animal Health	294	294	294	294
Freight	8,752	6,704	9,280	11,328
Fertiliser	8,971	8,467	9,097	9,601
Repairs and Maintenance	200	200	200	200
Labour	900	900	900	900
	19,117	16,565	19,771	22,323
Increase Over N.P. at 1/16.2 ha				
Animal Health	355	355	355	355
Freight	9,846	7,542	10,440	12,744
Fertiliser	8,971	8,467	9,097	9,601
Repairs and Maintenance	200	200	200	200
Labour	900	900	900	900
	20,272	17,464	20,992	23,800

TABLE 3

Estimated cash surplus for different situations

Cash flow item	$ p.a.			
	Abingdon	Highbury	Strathburn	Merluna
Over N.P. at 1/8.1 ha				
Additional Returns (Inflow)	20,058	20,058	20,058	20,058
Additional Costs (Outflow)	19,117	16,565	19,771	22,323
Cash Surplus (Net Flow)	941	3,493	287	-2,265
Over N.P. at 1/16.2 ha				
Additional Returns	21,278	21,278	21,278	21,278
Additional Costs	20,272	17,464	20,992	23,800
Cash Surplus	1,006	3,814	286	-2,522

"Inflow" and "Outflow" streams

The annual cash flow pattern generated by the development is shown in Table 3. This information together with the data in Table 1 enables an identification of the inflow and outflow streams associated with the investment. For simplicity it was assumed that the fencing and watering facilities had an effective life of 20 years and that their "salvage value", together with that of the pasture stand itself, was zero at the end of both the 10 and 20 year planning horizons. It was also assumed that zero production occurred in year 1, and full production thereafter. In reality some low level of production would occur in year 1, while commercial experience in the far north suggests (Anning pers. comm.) that stocking rates of 1 beast to 2.4 ha are achievable by the second year. For Merluna the annual net flow is a negative one indicating that the investment is clearly unprofitable.

Return on investment

By discounting the above monetary streams it is possible to derive an "internal rate of return" (I.R.R.) on the investments. Only the I.R.R.'s for Highbury are positive being 3% and 4% for the 1/8.1 ha and 1/16.2 ha respectively with a 10 year planning horizon and 10% and 11% for the 1/8.1 ha and 1/16.2 ha respectively with a 20 year planning horizon.

Thus, with a long planning horizon the investment at Highbury, some 420 km by road from Cairns, is quite profitable while at Abingdon Downs only an additional 130 km further away, the result is quite unprofitable. Interpolating suggests that 480 km would be the maximum road distance from Cairns for profitability but after allowing for reduced returns through the effects of income taxation a distance of 400 road km would probably define a zone of profitability. A "broad brush" diagrammatic presentation of this zone is shown in Figure 2.

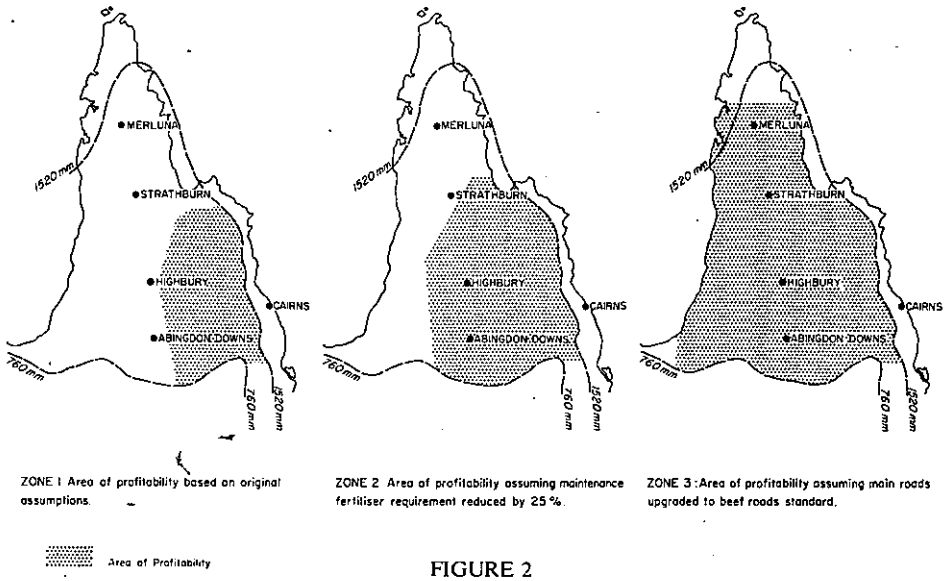

FIGURE 2

"Projected Zones of Profitability" of Legume Pasture Development

Sensitivity analysis

Variables of major significance in determining profitability include productivity of the Townsville stylo, beef prices, fertiliser prices and freight rates. In order to generalise our appraisal we have, in turn, varied the level of these main variables by

10% to determine the sensitivity of profitability to such variations. Since profitability has been shown to be negative for most areas, variables have only been changed in the direction of greater profitability.

A summary of the effect of these variations on the I.R.R.'s is presented in Table 4. This effect has only been calculated for a comparison of Townsville stylo production with native pasture stocked at 1/16.2 ha and for the 20 year planning horizon. It can be seen that the return on investment is most sensitive to a variation in beef prices and least sensitive to a variation in fertiliser prices.

TABLE 4

Sensitivity of internal rates of return to parameter variations

Parameter	Original I.R.R (%)				Adjusted I.R.R (%)			
	Abingdon	Highbury	Strathburn	Merluna	A	H	S	M
Townsville stylo productivity	–	11	–	–	5	16	1	–
Beef prices	–	11	–	–	7	18	3.5	–
Fertiliser price	–	11	–	–	0.5	13	–	–
Freight rates	–	11	–	–	3	14	–	–

TYPES OF GOVERNMENT INTERVENTION

From the above it appears that from an economic point of view there is no likelihood that graziers beyond about 400 road km from Cairns would be interested in undertaking this type of development. Thus in the future the adoption of this technology is likely to be (as it has been in the past) only undertaken by a small number of graziers and then only on a small-scale basis. Assuming that this sort of scenario is unattractive, the question arises, as to what types of government intervention might change it in the required direction. Of the four main determinants of profitability it has been suggested that the price of beef is the most important. However, in that these prices are largely determined by overseas demand there is little that can be done (except very indirectly eg. the support of freer trade) by governments that is likely to produce desired movements in these prices. But the other three examined do offer possibilities in that they are amenable to change through public expenditure.

As far as productivity is concerned the chief doubt at present seems to be the stability of Townsville stylo pastures given the infeasibility of close management. A recent note on this aspect (Anon 1973) indicated that Caribbean stylo appears to have superior survival characteristics and, being a perennial, it should provide more stable pastures than Townsville stylo. A re-allocation of research expenditure towards superior varieties such as Caribbean stylo is now under way.

The other important consideration relating to both productivity and stability is the quantity of fertiliser required. It has been calculated that a 25% reduction in the annual superphosphate requirement of the improved pasture from 126 kg ha^{-1} to 95 kg ha^{-1} (without any reduction in productivity) would extend the "zone of profitability" an extra 150 km from Cairns to about 550 km (Zone 2 in Fig. 2). Should future research work indicate that reductions of this sort are not possible, it would still be possible to secure an improvement in profitability by government subsidy on the cost of the fertiliser input. Such an arrangement existed for a number of years up until the end of 1974.

One of the most obvious and most frequently discussed forms of government assistance to cattle producers in remote areas of North Queensland is the provision of improved roads. Investment in social overheads of this nature would have the immediate

effect of reducing road freight costs on, for example, stock being transported to market. In addition, it improves accessibility and mobility for both property owners and those involved in servicing their needs — such as stock and station agents, veterinarians and extension personnel.

Recent costs of road transporting large mobs of cattle from the Gulf to the main northern rail-line via the Julia Creek to Normanton beef road provide some indication of the effect that the establishment of similar roads in Cape York might have. 1972-3 rate for stock turned-off from properties in the Gulf region were as low as 30-35 c km^{-1}. Assuming that rates in the Gulf would fall to something above this level, say 50 c km^{-1} (or half the \$1 km^{-1} originally adopted) the dramatic effect that this would have on profitability is indicated in Table 5. A "broad-brush" diagramatic presentation of this is shown in Figure 2. From this data investment in pasture development is estimated to become quite profitable over long planning periods even in areas as remote as Merluna — 700 odd kilometres by road from Cairns. In addition the adoption of shorter planning horizons (10 years) would not generally render such investments unprofitable except for the most remote part of the Peninsula.

TABLE 5

Estimated internal rates of return if sealed beef roads provided

Planning horizon	I.R.R. (%) Abingdon	Highbury	Strathburn	Merluna
10 year	12%	18%	10%	3%
20 year	17%	20%	16%	10%

Thus, while governments intervene in a number of ways simultaneously — such as continued expenditure on agrostological research together with gradual extension of the beef roads programme — the above analysis leads us to advocate that the most effective way of achieving pasture development in Cape York would be the continuation of the beef roads programme. Upgrading of the Mungana-Highbury link announced in July 1974 represents some progress in this regard. Looking further ahead, the provision of a sealed road from Mareeba through Laura and Coen to Weipa would service the large areas of country designated as suitable by Begg (1972). This, together with the provision of varieties that overcome the problem of pasture stability, should substantially lower the barriers presently inhibiting development of this far northern pastoral environment.

While Government action by way of beef roads, pasture research etc. must be subject to specific examination from a national point of view a fundamental observation can be made regarding further development of our extensive beef industry. A consensus exists (for example, Davidson 1965; Lougheed 1973) that Australia's comparative advantage lies in rural industries and more particularly in those which are land intensive. This combined with increasing overseas consumption of beef as incomes rise, indicates good prospects for further development of areas like Cape York Peninsula.

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