COMMERCIAL USAGE OF IMPROVED PASTURES IN THE AUSTRALIAN SUBTROPICS

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ABSTRACT

In the subtropics of eastern Australia sown and naturalised grasses are dominant in improved pastures in coastal areas from the Tropic of Capricorn to Taree, in the brigalow areas and in some semi-arid areas. Despite a large number of species which have been introduced and released (ca. 100), only a small number are used commercially. Temperate legumes (white clover, lucerne, medics) have been more successful than tropical species, most of which have failed to persist in the paddock. The early impetus to pasture development seen in the early 1970's has not been sustained due to livestock prices, costs of superphosphate, the loss of better class grazing land to cropping and the cessation of government incentives. A large potential for increased areas of improved pastures remains to be realised in the subtropics.

The potential for replacing existing vegetation with high-yielding grass-legume pastures was amply demonstrated in many experiments but often could not be sustained commercially, with changing beef prices. It was therefore inappropriate to many producers. The ecological problems now facing pasture development are long term changes in botanical composition under grazing, timber regrowth and maintenance of effective legumes under low fertility conditions. Economics of beef production from improved pastures depend on beef prices, terms of trade and the integration of cropping with beef production. Future research should aim for legumes and grasses which naturalise and persist under grazing and lower fertility levels, and must recognise the need for long term stability of grasslands.

INTRODUCTION

The pastoral area described in this paper, has been defined as the subtropical region with summer rainfall in eastern Australia. This extends south from the Tropic of Capricorn to Taree (32°S) on the N.S.W. coast. Inland, it includes the Darling Downs, brigalow lands, the semi-arid regions of south west Queensland and parts of the slopes and plains of New South Wales.

We have defined effective sown pasture (ESP), as pasture predominantly of sown and/or introduced species whose productivity at the time in question is superior to the native pasture in the area. It has been acknowledged that areas in which annual medics, white clover, paspalum, kikuyu grass have naturalised, have not been included on estimations of effective sown pasture. Development of sown pastures in the subtropics were reviewed by Cameron (1975), Colman and Mears (1975) and Pulsford (1980). This paper reviews the role of sown pastures in the three farming systems, industry trends, factors affecting pasture development and proposed changes to research objectives.

ROLE OF PASTURE IN FARMING SYSTEMS

Cattle production in coastal regions

Beef and dairy production are the major activities of the coastal region. Dairy production declined greatly between 1960 and 1975, leaving the remaining dairy farms on the alluvial land and basaltic plateaux. Summer milk production is based on naturalised or sown subtropical grasses often supplemented with concentrates or molasses. Winter production relies on areas of temperate forage species like oats, ryegrass fertilized with nitrogen and clovers, often under irrigation.

The main beef enterprises on poorer soils and steeper topography are breeding store weaners and growing out steers. Soils frequently have duplex profiles but most have the common characteristic of low phosphorus levels. The pattern of cattle growth is strongly seasonal with annual turnoff occurring in late summer and autumn. Stocking rates are relatively low (1 breeder per 3-7 ha) being determined by the winter carrying capacity. Calving rates vary widely between properties, but the region's average is estimated to be 65 per cent with weaning weights from 120-180 kg.

Cattle graze native and naturalised pastures composed mainly of mat grass (*Axonopus affinis*) in the higher rainfall coastal strip and speargrass (*Heteropogon contortus*) in Queensland, where the Eucalypt forest was ring-barked. The main improved herbage species in the higher rainfall area south of Gympie have been kikuyu grass (*Pennisetum clandestinum*), paspalum (*Paspalum dilatatum*) and setaria (*Setaria sphacelata*). Rhodes grass (*Chloris gayana*), green panic (*Panicum maximum* var. *trichoglume*) and setarias have been sown in the hinterland and further north. Improved legumes sown on a wide scale have included white and red clovers in the higher latitudes receiving effective winter rainfall and *Macroptilium atropurpureum*, *Desmodium intortum*, *Lotononis bainesii* and various stylos in Queensland. The most persistent legumes have been fine stem stylo (*Stylosanthes guianensis* var. *intermedia*) and naturalised and Haifa white clover (*Trifolium repens*).

Cropping and grazing on the slopes and Darling Downs

The rapid expansion of intensive grain cropping, based on opportunistic, crop-fallow systems for wheat, sorghum and oilseeds, occurred on the N.S.W. slopes and plains, the Downs and central highlands in the late 1960's and 1970's, and is continuing into marginal areas. Except for clearing brigalow vegetation, where the establishment of grass pastures for beef production was encouraged by the Brigalow Development Scheme, sown pastures are not used to maintain or restore fertility on red earth or cracking clay soils even though research has shown clear advantages (Lloyd 1984; Holford 1980). Despite increasing threats of soil erosion, degradation of surface layers and compaction, there are no signs of an early return to a pasture phase. A ley farming system has not proved attractive for a number of reasons including higher net returns from cropping than from livestock and delays in transition from one enterprise to another (Leslie 1983).

Beef cattle raising is the major grazing enterprise on brigalow lands based on sown rhodes grass, green panic and buffel grasses, which presently account for the largest areas of sown pasture. The problems of declining soil nitrogen levels, reduced turn-off rates and opportunities for cropping older pasture land are, belatedly, receiving attention (Robbins pers. comm.). Legumes have rarely been sown in brigalow land but lucerne has been planted extensively for grazing on the N.S.W. slopes and on the Downs. Annual medics have naturalised at higher latitudes in those areas with sufficient winter rainfall.

Extensive grazing on semi-arid land

Although most of this region carries native vegetation where cattle and sheep are ranched extensively, there has been an expansion of cropping particularly in north west New South Wales. On better class soils in the south west and Maranoa areas of Queensland - particularly soils supporting Gidgee (*Acacia cambagei*), land has been cleared and sown with buffel grass. Opportunity cropping based on long fallow, is increasing.

On the heavy clay soils, Mitchell grass (*Astrebla* spp.) is the most productive species but has not regenerated after cropping. Annual winter species (*Medicago polymorpha*, *M. minima*) have become naturalised in the south west of Queensland (Blumenthal and Hilder 1984) and at Walgett (Belotti pers. comm.) but sown pastures do not contribute greatly to livestock production.

TRENDS IN PASTURE DEVELOPMENT

The area of new pasture plantings in subtropical Queensland increased into 1973 but fell sharply after the slump in beef prices (Fig. 1). In Queensland, the rate has been influenced by government sponsored schemes like the Dairy Pasture Subsidy and Brigalow Development Schemes. It is difficult to see industries or vegetation zones likely to attract this type of assistance in the future (Weston *et al.* 1981). Except for a brief recovery in 1977/78, the total area of ESP has remained virtually unchanged for five years, but has shown a sharp decline in coastal sowings. This is opposite to the generally optimistic conclusions reached by Cameron (1977) and 't Mannetje (1984).

The largest area of sown pastures occur in the cropping zones, brigalow, the semi arid areas and on the slopes of New South Wales (Fig. 2). In coastal New South Wales, the area of sown pastures has decreased from 387,000 ha in 1968 to 148,000 ha in 1984. Improved pastures have been planted on the best land, in terms of slope and fertility which also has the highest potential for cropping. For example in the brigalow shires there was a 25% increase in cropping during the period 1974/75 to 77/78 which was accompanied by a 12% decrease in sown pastures. The reduction in sown pastures in the higher rainfall region has been caused by fertility decline, loss of sown species and invasion of native grasses and mat grass.

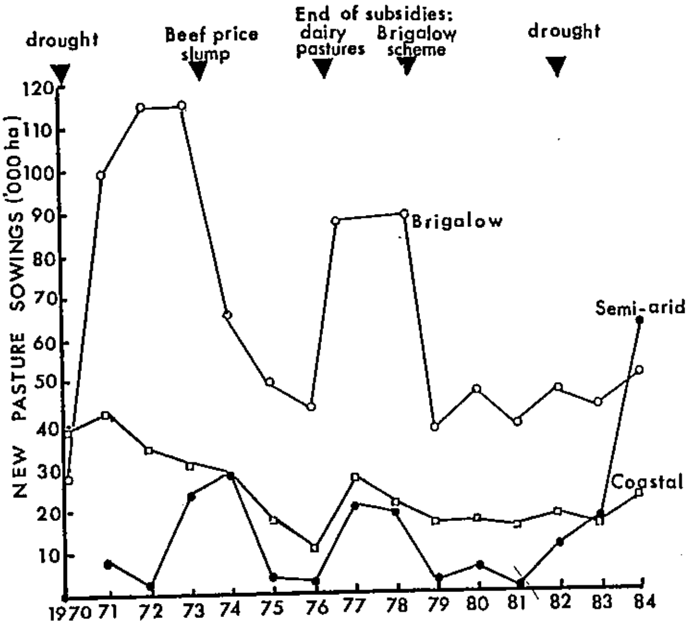

FIGURE 1
Area of new pasture plantings in subtropical Queensland

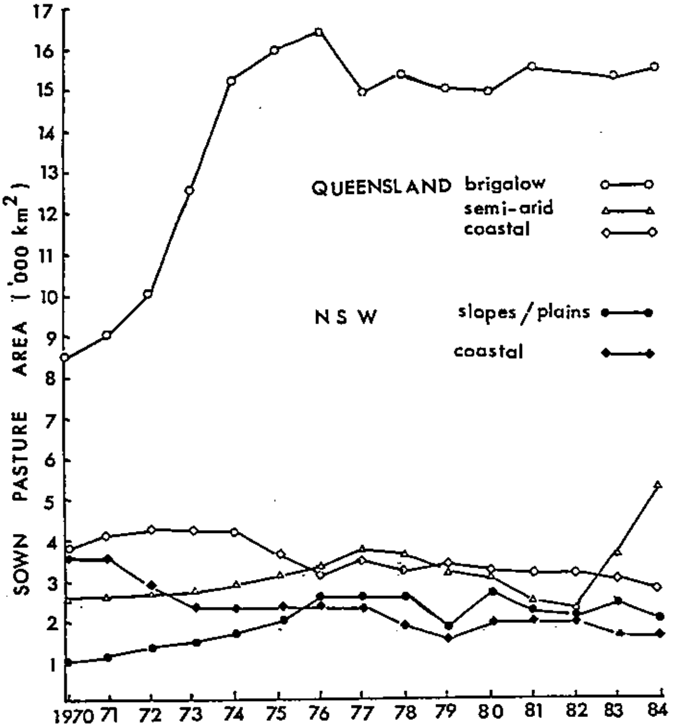

FIGURE 2
Area of total effective sown pastures in subtropical Queensland and northern New South Wales

Weston et al. (1981) calculated the current and potential areas suitable for different forms of land use in Queensland. Only a small proportion of land with sown pasture potential, ranging from 25% in the Fitzroy region to 3% in the south west, has been developed. The greatest potential for sown pasture is in the brigalow, semi-arid woodland and coastal black spear grass regions, which could carry an increasing part of the beef cattle herd in Queensland if development takes place. They noted the dangers of overgrazing on remnant native pastures, if cropping expands without a corresponding increase in sown pastures.

SPECIES AND FERTILIZER USE

The total number of grasses (59) and legumes (38) released for improving pasture in Queensland were listed by Cameron (1977) and their fate described. Sixteen grasses and 10 legumes have naturalised in some areas of the state. From 20 additional species which held promise for increased plantings in 1977, only 10 have been used on a limited scale up to 1985.

The potential area for various sown pastures has been estimated by Weston et al. (1981) who used an index of productivity and persistence to rate species adapted to different soil and climatic environments in Queensland. In general the grasses especially rhodes, buffel and green panic, have a far wider area of adaptation than legumes. Many tropical and temperate legumes (including annual medics, lucerne and clover) are adapted to smaller areas. There is a lack of suitable adapted legumes in the cropping areas and in the south west of Queensland. Weston points out that some of the reference species may not tolerate normal management conditions and hence the figures overestimate commercial potential. Siratro and desmodium are examples with a wide range of adaptability but poor persistence, disease or management needs, have restricted commercial usage (Brown 1983). Other new legumes present problems in seed production (e.g. Kenya clover *Trifolium semipilosum*, Bargoo jointvetch *Aeschynomene falcata* and lespedeza *Lespedeza striata*). The net result of these limitations is that only a few species have been used commercially.

It is likely that temperate legumes will continue to be sown widely in both hinterland and coastal environments for winter and spring production. For example, lucerne, annual medics and possibly serradella (*Ornithorpus compressus*) are used on suitable soils in lower rainfall areas, while clovers and *Lotus* are sown in the coastal areas south of Gympie. For the subtropics, *Stylosanthes* with resistance to anthracnose and species which persist under heavy grazing (such as *Cassia rotundifolia*, *Aeschynomene falcata* or *Vigna parkerii*) will be needed for the extensive grazing industry. There is an urgent need to continue the search for adapted summer legumes for brigalow soils. Weston et al. also forecast that the rhodes grass area is likely to expand in coastal and subcoastal land. Species better able to establish on heavy clay soils like purple pigeon grass (*Setaria porphyrantha*), *Bothriochloa insculpta* and creeping blue grass (*B. pertusa*), may compete with the *Panicum* species in the Darling Downs. Grasses adapted to heavy soils and lower fertility, like *Dichanthium*, *Bothriochloa*, and *Heterogopon* may replace buffel grass as soil fertility declines in traditional buffel areas.

The main pasture research effort in the late 1960's sought to correct phosphate deficiencies and to select legume species responsive to applied phosphorus, at a time when phosphorus prices were low. When applications of superphosphate were reduced after the slump in beef prices which coincided with the rise in world phosphate prices, the phosphorus responsive legumes suffered and associated grasses declined on many low fertility soils. On brigalow clay soils, falling available nitrogen levels, rather than phosphorus, have led to pasture decline.

The total area fertilized in coastal Queensland and New South Wales increased from 1968, reaching a total of 390,000 ha in 1974, but dropped by 50 per cent in 1974/5 after the beef price slump. The rates of superphosphate applied on the coastal pastures remained remarkably constant at 260 kg/ha before the slump and about 175 kg/ha thereafter, but the area fertilized has not yet recovered.

Despite many grazing trials which have shown a large effect of combining superphosphate and legumes on phosphate-deficient soils (Evans 1970; Cohen et al. 1984) graziers have not regained confidence in superphosphate use yet, even though most appreciate its benefit. The area of effective improved pasture is minimal (estimated to be 1.5% of potential sown pasture land in coastal Queensland).

INDUSTRY TRENDS

For a broader perspective, we must view trends in different industries if the future path of research and development is to be relevant. Over the past twenty years, the terms of trade for the primary producer have declined by about 2% per annum, and this has increased to about 8% per annum between 1980 and 1984, restricting farm cash surplus for high input pastures. In addition, the real price of beef, wool and wheat has declined since 1955, despite wide fluctuations (Reeves et al., 1984). Another trend is the increasing volatility of beef prices over the past decade. While there have always been cycles and depressions in the industry, their speed may have increased. Certainly there is no long term confidence in the beef market and few beef producers would be willing to enter heavily into debt. We consider the risk factor to be of overriding importance in the selection of new pasture species and for adoption of pasture improvement in general.

The expansion of cropping into areas of our best pasture has the danger of relegating animal production to second class land. This development has been encouraged by new technology which has been more profitable to apply in the broad acre cropping industries than with livestock. There is presently a world grain surplus. Also many Asian countries are now self-sufficient, or even export grain. Simultaneously a major demand for good quality red meat has been created in Japan and other industrialised south east Asian countries. Suitable young beef can be supplied from the higher soil fertility areas from pastures and forages, but not from most pastures in the coastal region, without legumes and phosphate application. While some earlier attempts at lot feeding have not always been successful, grain fattening store cattle reared on low fertility soils, may become economic depending on relative prices of store cattle and grain. Alternatively areas of high output pastures such as leucaena, temperate annual pastures or nitrogen fertilized grasses could provide a quicker turnoff of steers for the export market.

In the broadacre cropping areas there is also the decline in soil fertility, even in the clay soils after a number of years of cropping. This will require improved crop management, minimum tillage and rotations, which could include grain and fodder legumes or leys, to halt this trend and improve fertility. In the drier marginal cropping areas, the problem of re-establishing permanent pastures after cropping is becoming critical.

RESEARCH

The pasture research effort in the subtropics from 1960 to the mid 1970's has been concentrated in the higher rainfall areas because of their higher potential. The philosophy behind the C.S.I.R.O. and State Department's research programmes, was to emulate the pasture development in temperate Australia which recognised the role of plant nutrient deficiencies in limiting animal production. Researchers aimed at maximising the return for their effort by developing widely adapted and high producing species to replace native vegetation, e.g. rhodes grass/siratro. Even as late as 1977, Cameron was advocating that plants should have broad adaptability for commercial use.

A "conventional" research programme to evaluate a new species involved sward production trials, soil fertility and compatability studies, measurement of animal production in some cases and finally, seed increase. The systems were often designed to maximise output per unit area or per head, without covering the range of lower fertility levels or high grazing pressures experienced under commercial operations. The results of this approach were long lead times before a species was released. Also the restricted suite of species offered to the grazier were often dependant on either grazing management, specific Rhizobium needs or continued fertilizer inputs for their survival. The element of risk, together with high seed costs, have led to unattractive rates of return on investments in pasture improvement. In a period of rapid economic change, many results became irrelevant to the needs of the commercial producer.

Research should be able to provide answers to four basic management questions posed by the grazier; what can he do, how much will it cost, what will happen in the long term and what will be the return from his investment? The main problems now facing pasture development can be described as economic and ecological. Economic problems are obviously of primary importance if a property owner is considering spending money, in the present economy. While research cannot control off-farm costs or prices, it can identify areas where inputs can be used efficiently. Ecological problems are those arising from changes in the grassland systems. Examples are; heavier stocking with hardier Zebu-cross animals, the introduction of a legume (so affecting botanical composition), reducing fires, less control of Eucalypt regrowth or the gradual decline in soil fertility.

Our pasture philosophy requires a base grass/legume pasture of native and naturalised species that can withstand the pressures of overstocking or drought and respond when climatic or economic conditions improve. This grass/legume pasture would be fertilised with superphosphate when beef returns are adequate for an economic response as proposed by Cohen et al. (1984). Residual fertilizer may maintain productivity for short periods but the species should persist without fertilizer. Have we placed undue emphasis on too few species with broad adaptation, which have disappeared in commercial sowings because specific climatic or edaphic needs could not be met? It follows that a wider range of legume and grass species is needed in both coastal and hinterland climates to cover variation in micro-climate and soils as advocated by O'Brien (1975). Under medium and low rainfall, long term stability of the grassland and soil resources may require a change in the criteria for selection. Grasses which do not increase animal production immediately, but confer ecological stability over time may be needed. Examples are Digitaria didactyla naturalised in S.E. Queensland, creeping blue grass (B. insculpta) on clay soils or Mitchell grasses following a cropping phase.

A re-orientation of research activities is taking place to meet these goals and to make research more relevant to the farming community, particularly under reduced funding. Examples of these initiatives are the testing of legumes for heavy grazing (R.M. Jones pers. comm.), effects of low phosphorus applications in pasture systems (Kerridge 1986; Dicker and Garden 1986) and oversowing technology for native pasture. Various mixed crop/pasture options within a farming system framework will need to be tested by a team of crop, livestock and other workers. The consequences of sowing new pasture species need to be assessed under commercial conditions, by measuring botanical changes, long term persistence and possibly diet selection with animals fitted with oesophageal fistulae. Finally, methods of rapidly bulking-up seed supplies of new species will need to be devised to allow assessment under grazing on properties. Research and extension workers would have a large impact on the pastoral industries in the subtropics if these changes in research objectives are adopted.

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