DAIRY PASTURES IN THE AUSTRALIAN TROPICS AND SUBTROPICS

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ABSTRACT

Dairy production in the tropics and subtropics utilizes a range of forage options including native and naturalised grasslands, improved tropical species, raingrown and irrigated temperate pastures, forage crops and supplements. These are incorporated into feed systems so that the dairy cow is presented with high quality forage over the entire year. The increased use of irrigation and nitrogen fertilizer have been the two most important factors in improving farm efficiency in recent years. Improved tropical grasses fertilized with nitrogen continue to contribute to dairy production, but tropical legumes do not persist under the high stocking rates required for efficient dairying. Annual temperate pastures have increased the efficiency of farms with irrigation. Energy rich supplements are required to maintain high per cow production levels.

INTRODUCTION

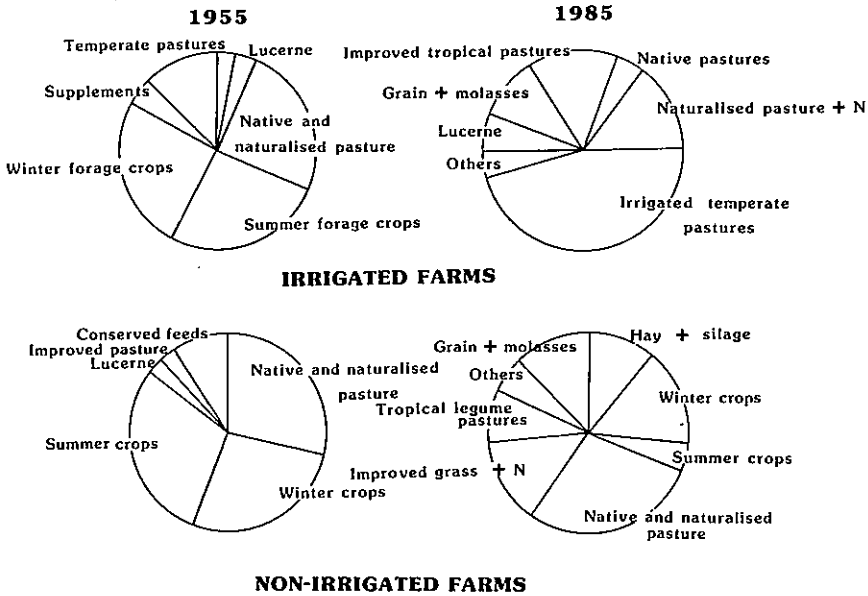
In the past thirty years, the dairy industry in the tropics and subtropics has changed, from one primarily producing cream for butter, to one where the major emphasis is the production of whole milk, with only the excess being used for less profitable manufacturing processes. In Queensland and Northern New South Wales, approximately 50% of the milk produced goes into the wholemilk market (Reason et al. 1983; B. Hamilton, unpublished data). These changes have required farmers to supply milk over the whole year and so a regular supply of feed in all seasons is necessary.

The increased use of irrigation and nitrogen fertilizer is the main factor contributing to improved farm efficiency. The grazing system, formerly based on native pastures, supplemented by forage cropping, has shifted to one based on improved pastures, particularly temperate species, use of nitrogen fertilizer and strategic feeding of energy concentrates (Cowan et al. 1983, Chopping et al. 1983) (Figure 1).

Farms without an irrigation capacity produce feed from native pastures, improved tropical species, forage crops, and supplements (grain, molasses, hay and silage). The major limitation is the unreliability of forage production. Growth is limited by rainfall and temperature, and is mainly summer orientated. Farms with irrigation can use the highly productive temperate species, particularly ryegrasses and clovers. Their production is less seasonal than farms relying solely on rainfed production. Provision of quality forage in autumn, highlighted in northern NSW by Murtagh et al. (1980), is still the main nutritional problem on all subtropical dairy farms. This review looks at the options, how they are intergrated into feed systems and where research effort should concentrate in the future.

FIGURE 1

Changes in the sources of dairy feed between 1955 and 1985



THE ROLE OF NATIVE AND NATURALISED PASTURES

Native and naturalised pastures have historically been the basis for dairying in Queensland and northern New South Wales (Cassidy 1971; Salkeld 1971; Murtagh 1980; Cowan et al. 1983). Native pastures consisting mainly of blue grasses (Bothriochloa and Dicanthium spp.) and spear grass (Heteropogon contortus) are only productive from late November to February. Annual yields are low compared to introduced grasses, but the main restriction to animal production appears to be the nutritive value which falls rapidly after maturity. Nutritional requirements of the milking herd are only fully supplied by native pastures during a short spring/summer period (Hutchings, 1965).

Naturalised species such as paspalum (Paspalum dilatatum), kikuyu (Pennisetum clandestinum), blue couch (Digitaria didactyla), mat grass (Axonopus affinis), and Pioneer Rhodes grass (Chloris gayana) are a more significant feed component. Animal production is generally higher than from native species because of better inherent quality, response to nutrients, and longer period of production. Within these species, there is considerable variation in potential productivity.The response of kikuyu to nitrogen is probably the most well documented in the subtropics, with increases in yield, protein and animal production (Colman 1971; Colman and O'Neil 1978; Murtagh et al. 1980). Paspalum yield increased six-fold with 200 kg/ha of nitrogen but mat grass showed no response (Cassidy 1971). Fertilizer has been used as a method of changing the botanical composition of pastures, by stimulating the more responsive species (Gartner 1969, Cassidy 1971). However, the popular method of improving pastures is to introduce a legume (Cook 1980; Millar et al. 1984).

Milk production from naturalised grass pastures of 2,000 to 2,450 kg/cow have been recorded (Jeffrey et al. 1970; Colman and Kaiser 1974). Production can be increased from 2,100 to 10,200 kg/ha by the use of nitrogen fertilizer and increased stocking rates (Colman and Kaiser 1974).

THE ROLE OF RAINGROWN TEMPERATE PASTURES

The use of temperate grasses under raingrown conditions has largely been unsuccessful in the tropics and subtropics with low production and poor persistence except in northern NSW. Those which have shown some persistence are Phalaris arundinacea and Festuca arundinacea (Ostrowski 1978; Ivory 1982a).

Temperate legumes have been more successful (ie. white clover in northern NSW (O'Brien 1970a,b) and coastal southeast Queensland (Ostrowski 1972)). Helyar (1984) has shown that it is suited to all of the dairying areas of the subtropics and tropics except the drier, sub-coastal area (Jones and Rees 1972). Productivity is limited by rainfall variablity and distribution, with yields fluctuating from year to year (Ostrowski 1972; Jones 1982; Ivory 1982b). Poor taproot survival as a result of fungal attack in late summer (Irwin and Jones 1977) predisposes white clover to drought in the sub-tropics more so than in temperate areas where roots survive longer (Jones 1980). Seedling emergence varies between years and is dictated by management and seed reserves (Jones 1982; Ostrowski 1972).

Peak presentation yields from white clover swards varied from 100 to 300 kg/ha in grazed coastal pastures (Jones 1982), but these figures do not reflect clover production as stock heavily, continuously and preferentially graze clover. Under cutting, white clover produced yields of 2,500 kg/ha in northern NSW (Garden 1977), 1,200 - 1,600 kg/ha on the Darling Downs (Ivory 1982b) and 225 kg/ha on the Atherton Tableland (Shaw and Quinlan 1978).

Kenya white clover (<u>Trifolium semipilosum</u> cv. Safari) is also used in raingrown situations . Cutting trials have shown that Safari has a higher yield potential than white clover in many areas (Jones and Rees 1972; Garden 1977; Shaw and Quinlan 1978; Ivory 1982b). Milk production per cow from Safari pastures is similar to that from white clover pastures (Stobbs 1976). Cook <u>et al</u>.(1985) found that the vigour of commercial Safari stands was related to phosphorus and potassium levels in the soils and to grazing pressure. Competition from grass rather than grass density may be important for productivity. Safari has performed better in northern NSW. K.R. Helyar (pers. comm.) has maintained a Safari content of 20 % for periods of up to 12 months in 7-year-old stands of kikuyu.

In some areas, particularly on the Darling Downs and the Fassifern, medics and lucerne are useful for dryland dairy production (Jones and Rees 1972). The main problem with the annual medics is also unreliability due to rainfall (Clarkson 1977). Apart from <u>Medicago polymorpha</u> which is naturalised in more fertile soils none of the improved medics are widely used for dairy production. Lucerne has the advantage of having both grazing and haymaking capabilities. The new breeding material from America has extended its growth potential into winter and into poorer soils.

THE ROLE OF TROPICAL PASTURES

The value of tropical species to dairying depends on their capacity to produce milk, and this is a function of both quality and quantity of herbage. Only small differences in milk production were detected between tropical grasses, and all were inferior to temperate species (Stobbs 1971a). Pure swards of <u>Macroptilium atropurpureum</u> and <u>Desmodium intortum</u> gave low milk yields per cow even though indicies for quality suggest that these legumes should have higher milk producing potential (Stobbs 1971a). Mixtures produce more milk per cow than pure swards of either grasses or legumes (Stobbs 1971b).

Both presentation yields and the morphology of the canopy of tropical pastures influences bite size and grazing time (Stobbs 1974a) and this influences milk production (Stobbs 1974b, Cowan 1975). The low leaf bulk density of pure stands of twining tropical legumes has been suggested as the reason for its poor milk production per cow (Stobbs and Imrie 1976). Cowan and O'Grady (1976) showed that grazing time and milk yields per cow were affected by pasture yields, reaching a peak at about 2,500 kg DM /ha. When pasture morphology was modified by slashing or changing the stocking pressure, milk production per cow was decreased, due to the loss in presentation yield. Grazing management decisions should be based on total pasture on offer rather than any pasture component (Davison and Cowan 1978a; Davison <u>et al</u>. 1981).

TABLE 1

Milk production from selected research projects on tropical and temperate pastures in Queensland and northern New South Wales

Location	Species	Stocking rate (cows/ha)	Milk production (kg) per cow	Milk production (kg) per ha	Recording period (days)	Reference
Atherton Tableland	Commercial survey	-	4100	-	lactation	Cowan et al.(1974)
Atherton Tableland	gn.panic/ glycine	1.3	4380	5690	lactation	Cowan et al.(1975)
		1.6	3870	6200		
		1.9	3870	7350		
		2.5	3360	8400		
Ayr	Pangola/ 675kgN/ha	5.9	4210	24840	lactation	Chopping et al.(1976)
		7.9	3240	25630		
Ayr	Couch/N	7.0	1910	13350	249	Chopping et al.(1982a)
	+ ryegrass	7.0	2250	15740		
	+ clover	7.0	2590	18100		
	+ clover/ ryegrass	7.0	2590	18140		
Atherton Tableland	Gatton panic/N	2.0	2940	5870	lactation	Davison et al.(1982)
		3.5	2540	8880		
Mutdapilly	Rhodes/N	2.0	2790	5580	280	Cowan & Lowe,unpublished results
		3.0	2530	7590		
Mutdapilly	Ryegrass/N	5.0	2800	14000	220	Moss and Lowe,unpublished results
		10.0	2480	24800		
	Ryegrass/ Clover/N	5.0	2930	14600		
		10.0	2300	23000		
Wollongbar	Kikuyu	2.5	2220	5540	lactation	Colman and Kaiser (1974)
		3.3	2030	6700		
		5.0	1900	9500		

Production levels per hectare from tropical grass/legume and grass/nitrogen pastures can approach those from temperate pastures (Cowan 1975; Colman and Kaiser 1974)(Table 1). Milk production levels per cow, however, are considerably lower than that from temperate pastures, and this is the major limitation with tropical species. Stocking rate is the major influence on production per unit area of land. Up to 7.5 cows per hectare can be used on irrigated, tropical grass/nitrogen pastures (Chopping et al. 1982a) but for stable mixed pastures, stocking rates of 1.6 cows/ha should not be exceeded (Cowan et al. 1975). Although milk production on tropical mixed pastures increased linearly to 8,400 kg/ha as stocking rates increased to 2.5 cows/ha, animals lost weight, milk quality was affected and the legume component disappeared at rates above 1.6 cows/ha.

Spackman (1978) suggests that only 38 % of improved dryland pastures on the Atherton Tableland maintained a vigorous legume component, while a further 17 % had some legume capable of regeneration. Similar data is available from southern Queensland (Lowe, unpublished results). Davison et al. (1982) have shown that the tropical legume component of degraded pastures can be regenerated by reducing the stocking rate or completely destocking for a period. Siratro-based pastures are intolerant of stocking rates above 1 cow/ha. The loss of the legume component is accompanied by a subsequent loss in animal production (Jones 1979; Walker 1981; Bishop et al. 1985). Once plant numbers and seed reserves have both degenerated, pasture degradation generally becomes irreversible (Jones 1979).

Despite the volume of research on them, twining tropical legumes have performed poorly in commercial dairy situations (Swain et al. 1970; Murtagh et al. 1980;Cowan et al. 1983). Alternative legumes are now being evaluated for high stocking pressure situations. Those showing promise include lotononis, Bargoo jointvetch, Safari clover, *Cassia rotundifolia* cv. Wynn, *Vigna parkeri* cv. Shaw, *Lotus pedunculatus* cv. Maku and *Arachis* spp. (Brown 1984). Grasses such as Callide Rhodes grass, Narok setaria, green and Gatton panic and kikuyu have performed well in the dairy situation.

Increased milk production per hectare by the use of nitrogen rather than legume-based pastures has been demonstrated in both north Queensland (Chopping et al. 1978; Davison et al. 1978b; 1982), southern Queensland (R.T.Cowan and Lowe, unpublished results) and northern NSW (Murtagh 1980; Murtagh et al. 1980). Nitrogen was used to increase pasture and milk yields in autumn and winter of a green panic/Tinaroo glycine pasture, particularly at higher stocking rates (> 1.6 cows/ha)(Cowan and Stobbs 1976). As in previous research (Jones 1967,1970; Wolf and Lazenby 1973), this reduced legume content. However this strategy did not increase milk production at Ayr, despite pasture growth rates being increased (Chopping et al. 1978; 1982a).

THE ROLE OF IRRIGATED TEMPERATE PASTURES

Traditionally, perennial temperate species have been used in irrigated pastures in the subtropics. These pastures produced 10,000 to 20,000 kg/ha/annum (Kleinschmidt 1964; Lowe et al.1981, 1984) and were based on perennial ryegrasses and white clover. Considerable research was conducted on selecting a more persistent perennial grass (Cameron 1967; Lowe 1978; Lowe and Bowdler 1984), management strategies (Cameron *et al.* 1969; Grof *et al.* 1969; Kleinschmidt 1964) and an increased summer growth component (Jones *et al.* 1968, Lowe *et al.* 1981). However this pasture type has been replaced by annual sowings of ryegrass/nitrogen and ryegrass/clover.

Pure ryegrass pastures are sown at high seeding rates (up to 40 kg/ha) and are intensively fertilized with nitrogen (O'Grady and Cassidy 1976). Mostly, annual ryegrasses are used but mixtures of annuals and perennials lengthen the growing season (O'Grady and Cassidy 1976). Sowings can utilise fully prepared or chemically prepared seedbeds or use a mulch strike technique (Chopping *et al.* 1982b). Nitrogen application rates are high; recommendations of 50 kg/ha/application can apply up to 450 - 500 kg/ha over the growth period (Chopping *et al.* 1983).

Coastal southern Queensland and northern NSW appear to provide ideal growing conditions for ryegrass, provided all moisture requirements are supplied by irrigation. Only in coastal northern Queensland is ryegrass production low (Goodchild *et al.* 1982), probably because high temperatures restrict the growing period. In cutting experiments in southern Queensland, ryegrass yields of over 20,000 kg/ha have been recorded over a 200 day period (Lowe *et al.* 1984), and this is more than in temperate environments (Harris *et al.* 1977; T.Launders, pers. comm.). Newer cultivars, primarily Midmar and Tetila, have shown increased dry matter production with a better distribution of forage, better disease resistance (Robbins and Faulkner 1983; Lowe *et al.* 1984), and improved milk production (Lowe *et al.* 1985).

Milk production from ryegrass pastures is higher than from other sources of feed during the cool season. Chopping *et al.* (1982c) demonstrated that milk production from ryegrass/nitrogen pastures was higher than nitrogen fertilized pangola/couch pasture, producing up to 11.6 kg milk/cow/day. At Mutdapilly, ryegrass/nitrogen pastures grazed with unimproved native pastures, also produced 11.6 kg milk/cow/day (R.J.Moss and Lowe, unpublished results). On farms, production levels of 3,800 litres/lactation have been demonstrated (Oliver and Busby 1980).

The other annual system utilizes high seeding rates of temperate legumes such as *Trifolium repens* (Ladino or Haifa), *T. subterraneum* (Clare), *T. resupinatum* (Persian), *T. pratense* (red) or *T. alexandrinum* (berseem), with up to 5 kg/ha of ryegrass (Chopping *et al.* 1983). Forage production from this system (10,000 - 15,000 kg/ha) is lower than the nitrogen fertilized system but milk production levels are similar because of the higher forage quality (Moss *et al.*1985). The risk of bloat and a lower stocking rate threshold detract from its value but cost savings in nitrogen fertilizer make it an attractive feed alternative (Chopping *et al.* 1983).

THE ROLE OF SUPPLEMENTS

Although pasture is the cheapest source of feed, the quantity and quality varies greatly through the year and in many circumstances the feeding of supplements to cows is both necessary and economical. In 1983, farmers in southern Queensland spent an average 19% of their gross income on concentrates, twice as much as on fertilizer (B. Moon, pers. comm.). The most commonly used supplements are those high in energy such as molasses and cracked grain. The responses to these supplements is similar on a dry weight basis (Cowan and Davison 1978). The long-term response to the feeding of energy concentrates to Friesian cows is approximately 1.1 kg milk per kg of concentrate fed (Cowan 1985).

On non-irrigated farms, there is considerable reliance on stored forages. In Queensland there is a reliance on purchased or home-grown hay which is made from lucerne, failed crops, or crop stubble. Maize silage has a valuable role to play by filling feed gaps, particularly in autumn and spring. Currently, silage is not widely used but its popularity is increasing, particularly in northern NSW where the percentage of farms making silage has increased from 1.7% in 1978/79 to 8.4% in 1983/84 (Hamilton and Griffiths 1984).

THE ROLE OF FUTURE RESEARCH

Currently, the average production per cow in Queensland is 2,700 litres per lactation compared to 3,300 litres for the whole of Australia (Anon. 1985). Major emphasis in the short term should aim at increasing production levels per cow and addressing the autumn feed gap problem. In the long term, both research and commerce must aim to increase production per hectare of forage options otherwise the increasing costs of land, labour and inputs will rapidly erode the profitability of dairy farming. This can be achievied by the use of nitrogen on grass pastures, management factors such as the timing and frequency of fertilizer application and grazing methods for maximum utilisation.

Research on raingrown temperate species should concentrate on the use of perennial grasses with nitrogen in the coastal areas of northern NSW. Research to elucidate the presistence problems with Safari clover is warranted. Little further research on temperate irrigated pastures appears necessary, except in north Queensland and in evaluating newer material. Within the tropical species, there is scope for the development of grasses with higher quality forage, and better seasonal distribution. Legumes will perform a back-up role for night pastures, to improve broken country and to improve pastures for replacement stock. The most urgent need is for a productive and persistent legume which can contribute to animal production at stocking rates of between 1 and 2.5 cows/ha.

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