Balancing water use efficiency and milk production in the sub-tropics

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Introduction Queensland dairy farmers have had to confront in the last 5 years deregulation of the milk pricing system, resulting in a 25% reduction in farm gate price for milk in the year 2000, and drought. Many storage dams are significantly below capacity and regulatory authorities have imposed restrictions on irrigation water allocations. Major changes in farm business strategies were needed to overcome the shortfall in milk income. Production systems had to change to deliver more milk more efficiently and become more profitable. A farmlet study was developed in the sub-tropical dairy region of Queensland to evaluate 5 very different farm systems identified by a group of experts as capable of tripling production whilst achieving a 10% return on assets and 600,000 L/labour unit. This paper compares the water use efficiencies and milk production of these systems.

Materials and methods The 5 farmlets included M1 - raingrown tropical grass pastures and oats, M2 - 20% of the farm area planted to irrigated annual ryegrass and the remaining area to raingrown tropical grass pastures, M3 - 10% of the farm irrigated and planted to annual ryegrass and the remainder to forage crops, M4 - 90% of the farm planted to irrigated temperate pastures and summer forages, and M5 - a feedlot whose feedbase consists of irrigated temperate and tropical crops. All farmlets received equivalent to 3 t dry matter (DM)/head/year of purchased concentrate. Each farmlet consisted of 20 cows whose calving pattern reflected the forage production system. Defoliation practice, fertiliser and irrigation management were similar across the farmlets. Paddocks were managed to an agreed best practice, and forage growth rates were measured at each rotation. Milk production from forage was calculated using reverse feeding standards. Water use efficiency (WUE) was determined by either dividing milk from home grown forage or forage utilisation by irrigation plus rainfall.

Results The most water-efficient system for milk production was the feedlot system M5 using maize silage and barley hay as conservation, which avoided herbage wastage associated with grazing (Table 1). The high efficiency was in part at least associated with growing a crop of barley that recorded the highest WUE of all C3 species monitored with 2.1 t DM/ML. The herd in this system was milked 3 times/day and was fed as a feedlot hence the metabolic efficiency of this herd was higher compared to the remaining grazing systems, which also contributed to the high WUE of milk production. When comparing the grazing systems M1 to M4, the high irrigation, high quality temperate pasture system M4 recorded the highest WUE of milk production (Table 1). However, this system contained perennial temperate species whose WUE was comparatively low (less than 1.5 t DM/ML) compared to the short-lived annual species and summer forages. So although this system had the highest milk production it recorded the lowest WUE of forage production (1.1 t DM/ML). In contrast, the M3 cropping system recorded the highest WUE of forage with 1.9 t DM/ML. This system had the largest land area and contained the highest proportion of C4 forage crops that maximised total herbage utilisation and WUE of forage. But, the forage quality of C4 species was comparatively low compared to the C3 species so the WUE of milk production for this farmlet was low.

Table 1 Water use efficiency for milk production (‘000 L milk/ML) and forage utilisation (‘000 kg DM/ML), milk from forage (‘000 L), and rainfall and irrigation (ML) from April 2003 to March 2004

Farmlet system	Milk from forage (ML)	Water ML/farmlet			Water use efficiency	
		Rainfall*	Irrigation	Total	Milk	Forage
M1	78.6	66.7	-	66.7	1.18	1.4
M2	70.4	65.3	4.1	69.4	1.01	1.3
M3	83.0	73.7	5.0	78.6	1.06	1.9
M4	91.3	54.3	17.0	71.3	1.28	1.1
M5 (Feedlot)	114.3	41.4	9.5	50.9	2.25	1.2

* Derived from total rain received multiplied by winter and summer farmlet areas 2003/2004

Conclusions Optimising WUE by selecting highly water-efficient species had a greater effect on milk efficiency than the amount of water received through irrigation and rainfall. For instance, although the M5 system received the lowest volume of water, this system recorded the highest volume of milk from home grown forage. The WUE of forage production was increased with the selection of a feedbase that contained higher water use efficient species. However, exclusively selecting for water use efficient species will not maximise milk production. Farmers will need to find a balance between optimising WUE and milk yield for their farm system.