CONTRACT REVIEW

IMPROVED MANAGEMENT SYSTEMS FOR DAIRY REPLACEMENT HEIFERS

J.B. MORAN

Kyabram Dairy Centre, Institute of Sustainable Irrigated Agriculture, RMB 3010, Kyabram, Vic. 3620

SUMMARY

All too often, the attention dairy farmers give to rearing their young stock declines markedly after weaning. The weight of heifers at mating has effects on ease of calving, subsequent milk production and their longevity in the milking herd. For example, calving 2 year old Friesian heifers at 550 kg compared to 450 kg liveweight can reduce the time between calving and conception in their first lactation by 17 days and should increase lifetime milk yields by about 2300 L. In year-round calving herds, better feeding of young stock can reduce age at first calving, which also increases lifetime productivity. Despite the higher costs involved in improved heifer management systems, computer studies have shown it to be profitable to rear heifers to heavier pre-calving liveweights and/or younger ages at first calving.

This review summarises much of the information generated from Australian studies, then describes many of the current systems of heifer management, highlighting some of their shortcomings and suggesting where improvements could be made. The costs of rearing heifer replacements are briefly discussed together with the economic benefits of better rearing systems. Finally, details are provided of a technical information package currently being prepared by dairy specialists for dissemination amongst dairy farmers throughout eastern Australia, under the auspices of the Project 21 (NSW) and Target 10 (Victoria) dairy extension programmes.

Keywords: heifer management, milk yields, fertility, longevity

INTRODUCTION

Over the last 5 years, considerable Australian data have been generated which document the potential production benefits arising from better growth rates in dairy heifer replacements (eg Freeman 1993; Earle 1994; McLean 1995a). Such information is leading to a re-evaluation of feeding and management strategies on Australian dairy farms to increase liveweights (LW) of replacement heifers at point of calving and/or reduce their age at first calving.

When raising replacement heifers, dairy farmers have 5 major objectives:

1. Maintenance or expansion of herd size. Heifer rearing systems should provide sufficient animals to replace cows culled from the milking herd and allow for increases in herd numbers.
2. Calving by 24 months of age. Entry into first lactation by 24 months of age minimises the total non-productive days and maximises lifetime productivity (Cowan *et al.* 1974).
3. Sufficient growth for minimal dystocia at first calving. Heifers need to be large enough to calve without dystocia.
4. Maintenance of health. The prevention of clinical and subclinical disease plays a large role in the ability of replacement heifers to meet LW and age targets at first calving. Longevity and lifetime productivity are also affected.
5. Genetic progress. Replacement heifers should have higher genetic merit than the current milking herd. This may be expressed by increased productivity (both milk volume and solids), improved efficiency of production or enhanced resistance to disease.

All of these objectives are influenced by the management of young stock. This begins with a greater awareness of the need to give heifers a "good start to life". This includes:

1. Ensuring calves consume adequate amounts of good quality colostrum within 6 hours of birth,
2. Encouraging early rumen development by stimulating intakes of dry feeds by 4 to 6 weeks of age,
3. Minimising environmental stress by protecting calves from the extremes of weather, such as providing housing for their first 2 months of life.

A well managed calf rearing system can be best described as one which consistently produces healthy, weaned Friesian calves weighing 100 kg by 12 weeks of age. The management of the milk-fed calf has

been discussed in detail by Moran (1993). This review considers the benefits of improved feeding and management of heifers after weaning.

BENEFITS FROM BETTER GROWN HEIFERS

D.M. MCLEAN[A] *and M. FREEMAN*[B]

[A]Primary Industries (South Australia), Flaxley Agricultural Centre, Box 1571, Flaxley, S.A., 5153
[B]Dept of Primary Industries and Fisheries, Elliott Research Station, Box 236, Somerset, Tasmania, 7322

PRE-CALVING LIVEWEIGHT TARGETS FOR HEIFERS

What is the ideal pre-calving LW for Australian heifer replacements? Table 1 summarises the traditional (1980s) and revised (1990s) target weight for ages for Jersey and Friesian heifers.

Table 1. Traditional and revised target weights for ages in Jersey and Friesian heifers (modified from Moran 1993)

Age (months)	Jersey		Friesian	
	Traditional	Revised	Traditional	Revised
3 (fully weaned)	45-65	65-85	65-85	90-110
12 (yearling)	160-180	200-230	210-230	270-300
15 (mating)	200-220	245-275	260-280	330-360
24 (pre-calving)	320-350	380-410	410-430	520-550

There is considerable evidence that traditional targets for Friesians are too low to ensure that cows attain their potential productivity, particularly on farms where milking cows are well fed. This evidence will be discussed in the following sections. The revised targets for Friesians more closely match the US guidelines (Radostits *et al.* 1994) which seems logical because Australian Friesians are now genetically close to their US counterparts.

Should recommended target LW be the same for each Australian dairying area? Lean (1994) argues that optimum heifer LW should depend on the production system, calving pattern and the relative price of concentrates to milk. In systems where concentrate prices are high compared to milk, such as in seasonal calving areas where high per hectare production is sought, a pre-calving LW of 500 kg may be acceptable for Friesians and 400 kg for Jerseys. However, where milk prices are higher, such as in year-round calving systems aiming for high per cow production, 550 or even 600 kg may be a better target for Friesians.

Moss (1993) suggested that the optimum LW of heifers on a particular farm should depend on target herd mature sizes, namely 85% of their mature size before calving. Therefore, as herd production and mature cow LW increase with improved nutrition, target LW for heifers should also rise. An acceptable heifer pre-calving target LW for herds producing 4000 to 5000 litres per cow is 500 kg, but in herds producing 8000 L/cow, heifers need to calve at 580 kg.

If growth is not limited by undernutrition or disease, mature cow size is controlled by genetics. Breeding for animals with the genetic potential for large size and high potential production and then underfeeding them seems illogical. One solution proposed for New Zealand (N.Z.) dairying is a 3 breed rotation cross breeding programme to maintain a medium size mature herd, and also incorporate the advantages of hybrid vigour (Wickham 1995).

Current pre-calving liveweights of Australian heifers

Current average pre-calving LW of heifers in dairying areas across Australia and within a dairying region are very variable, and generally below current recommendations. From several surveys conducted throughout Australia over the last 3 years, herd averages for pre-calving LW of Friesian heifers calving at approximately 24 months of age varied between:

445 and 541 kg for 12 South Australian (S.A.) herds (McLean 1995a),
323 and 521 kg for 11 Tasmanian herds (Freeman 1995)
435 and 559 kg for 59 herds of contract reared heifers in northern Victoria (McLean 1995a).

In 13 Western Australia (W.A.) herds calving at an average of 29.4 months, Hough (personal communication) recorded herd pre-calving LW of between 467 and 615 kg. In 14 Queensland dairy herds calving at an average age of 29.8 months, Moss *et al.* (1996) recorded LW at 2 years of age of between 340 and 500 kg.

Pre-calving liveweight and milk production

Some of the earliest Australian research into heifer rearing was undertaken in northern Queensland. Cowan *et al.* (1974) monitored the performance of 78 heifers calving between 21 and 43 months, and with LW ranging between 363 and 681 kg. For heifers calving between 24 and 27 months, an increase of one kg LW led to an increase of 9 L in the first lactation and a total of 23 L milk over the first 3 lactations. They concluded that well grown 2 year old heifers produced as much milk as 3 year olds of the same LW, with the added advantage of an extra lactation in their lifetime. On 14 farms in southern Queensland, Moss *et al.* (1996) recorded a first lactation milk response from heavier heifers of 13 L for each additional kg in calving LW. This higher milk response also includes the effects of improved post-calving feeding.

Earlier work in N.Z. by McMeekan in the 1950s (cited in Bryant and McRobbie 1991) showed that Jerseys produced an extra 0.3 kg of fat in their first lactation for each extra kg of LW at calving, this being equivalent to 6 L milk.

More recent Australian research has confirmed the magnitude of these findings. The potential production increase with each kg increase in heifer LW at calving, determined with spring calving heifers at Elliott Research Station in Tasmania, was 4.1, 8.3 and 8.4 L in their first, second and third lactations respectively, giving a total of 20.8 extra L milk over 3 lactations (Freeman 1993). In a similar study involving 11 Tasmanian commercial dairy herds, the potential production increase associated with each kg increase in calving LW was 7.1 and 7.2 L in their first and second lactations (Freeman 1993). Preliminary analyses of data from contract reared Friesian heifers in northern Victoria found an increase of 5.8 L milk in their first lactation for each kg increase in heifer LW at calving (McLean 1994). This ongoing study will analyse a large amount of data from southern Australia, and when complete, should provide a better understanding of the relationship between heifer pre-calving LW and milk production. Furthermore, 2 other large studies currently in progress, at Camden in N.S.W. (Dobos *et al.* 1995) and at Hamilton in N.Z. (Penno *et al.* 1995) should also provide additional information.

Improved heifer nutrition, which is responsible for producing heavier heifers at calving, is only one factor affecting subsequent milk production. Nutrition after calving must also be improved to ensure that heavier heifers milk to their potential. Heavier heifers able to compete better in the herd with older cows, are better able draw on body reserves in early lactation and also have a greater capacity for feed intake.

Heifer liveweight and reproduction

The onset of puberty is related to LW rather than age. A current N.Z. study (Penno *et al.* 1995) showed that level of nutrition during rearing of Friesian heifers affected the percentage of heifers cycling. When comparing groups of heifers fed 3 levels of nutrition (high, medium, low) at 11.5 months of age, 95% of the high (268 kg LW) and 65% of the medium (242 kg LW) compared to only 2% of the low (186 kg LW) nutrition groups, were cycling. Following insemination, they found that the LW, age at puberty or previous nutrition, had little influence on age at conception or percentage of pregnant and non-pregnant heifers, probably because the reproductive performance of their low-fed group was enhanced by the CIDR progesterone synchronisation treatment which stimulated puberty in non-cycling heifers. They concluded that Friesian heifers should weigh at least 300 kg at mating to ensure that all animals are cycling normally. Thomas and Mickan (1987) considered minimum target LW in Victorian dairy herds for successful conceptions to be 220 kg for Jerseys and 320 kg for Friesians.

Results from Tasmania (Freeman 1995) indicate that heavier heifers tend to have better reproductive performance during their first lactation. There were fewer non-pregnant heifers and a higher percentage of first services were successful, therefore there were less services per successful conception. Fewer returns to service mean a tighter calving pattern, a desirable practice in seasonal calving herds. Higher first conception rates are also desirable in year-round calving herds because they lead to lower labour and semen costs with a reduced need for natural mating.

During their first lactation, lighter heifers will be in negative energy balance longer, commence cycling later and so will have greater difficulty getting back in calf. Elliot (1994) in N.S.W., calculated

that for every increase of 100 kg LW at calving there was a decrease of 17 days between calving and successful conception during the first lactation. N.Z. research has shown that the lightest 10% of heifers in a herd are 5 times more likely to be empty than the heaviest 10% (Macmillan 1994).

Heifer liveweight and calving ease

It is important that heifers commence milk production in their first lactation without significant calving problems. The stillbirth rate for unassisted births is 5% compared to 41% for those with dystocia (Cady and Burnside 1982), and US studies have found 24% of heifers had dystocia (cited in Radostits *et al.* 1994). As well as increased veterinary bills for assisted deliveries and the loss of calf value if stillborn, heifer performance is adversely affected through dystocia. Extreme calving difficulty has been found to increase the number of days to conception by 14 days and decrease first lactation milk yield by 650 litres (Djemali *et al.* 1987).

An important cause of dystocia is foeto-pelvic disproportion, which can be due to heavy calf weight or abnormal/undersized maternal pelvis. An undersized pelvis is often the result of poor nutrition prior to puberty, when the majority of skeletal development occurs. This is indicated by short wither height. A large field study in England showed that LW of Friesian heifers at mating had a greater influence on calving difficulties than either LW or condition score at calving (cited by Macmillan 1993). In this study, the percentage of heifers that had difficult calvings was 24% for heifers mated at less than 260 kg, 8% for heifers mated between 260 and 280 kg and 3 to 6% for heifers heavier than 280 kg at mating. Poorly reared heifers are then more likely to suffer dystocia, particularly when mated below 260 kg LW.

Heifers that are poorly reared prior to mating, then well fed between mating and calving, will tend to be overfat, with poor skeletal size. In fact, "catch up" feeding can contribute to higher birth weights, over-conditioned cows and more dystocia, with little improvement in milk yield (Macmillan 1993).

Pre-calving liveweight and culling rates

High wastage rates have been reported in heifers during rearing and in their first lactation. In N.Z., only 81% of heifer calves reared on dairy farms actually calve as 2 year olds while a further 14% are culled prior to calving as 3 year olds (Harris 1989). Tasmanian surveys have found that only 47% of the replacement heifers reared actually survived beyond their first lactation (Freeman 1993).

Heifers with lower LW at calving are more likely to be culled before completing their first lactation. For example, Freeman (1995) reported that the percentage of heifers failing to remain a minimum 150 days lactation increased from 0% when calved down at 550 kg LW or above, to more than 17% when calved down at 300 to 350 kg LW, while 36% of those heifers calved down at 300 kg or less were culled during their first lactation. Freeman noted that more light heifers were culled because of severe dystocia, which reduced their milk production or led to subsequent health problems, rather than through failure to conceive. Furthermore, fewer heavier heifers returned to service and fewer failed to conceive in their first lactation (Freeman and Walker 1993).

Age at first calving

It is generally accepted that heifers should enter the milking herd at about 24 months of age, the optimum age for maximum lifetime production and herd profitability (Cowan *et al.* 1974). However, in WA, NSW, Queensland, SA, Tasmania and Victoria, age at first calving averages 33, 33, 31, 30, 27 and 27 months, respectively (Hough 1992). Calving at 24 months of age is particularly important with seasonal calving herds, because delayed calving can reduce subsequent milk production through lower peak yields, due to poorer pasture quality in late spring or early summer at the time of peak yields, and also through shorter lactation lengths.

In year-round calving herds, the decision to begin breeding heifers is often based on LW, body size and age, or a combination of these factors. As age at first calving decreases, lifetime production and herd life span increase (Radostits *et* al. 1994). Although heifers calving at a younger age may have lower production in their first lactation, their production per day of herd life and lifetime total yields are significantly higher than heifers with higher ages at first calving. Furthermore, a lower age at first calving reduces the number of replacement heifers required to maintain a similar culling rate in the milking herd. Reducing generation interval will also increase the rate of genetic progress in the herd. If heifers are calved at similar LW, reducing age at calving has no detrimental effects on production.

Disease problems during milk rearing can reduce heifer growth rates and increase the age at first calving. For example, a Canadian study showed that heifers treated for scours as calves were 3 times more likely to calve after 30 months of age than non-infected calves (Waltner-Toews *et al.* 1986).

Possible disadvantages of rearing heavier heifers

Many studies have shown that rapid growth during the "critical period" prior to puberty (approx. 3 to 10 months of age or 90 to 200 kg LW with Friesians) can result in fat deposition in the udder and lower subsequent milk production (Hoffman and Funk 1992). However, Lean (1994) has suggested that such observed milk depressions may have resulted from high energy and/or low protein intakes during this "critical period', and that fatty udder syndrome may not be a problem with balanced diets, particularly those providing sufficient rumen undegradable dietary protein. To minimise this problem, heifers should not grow faster than 0.8 kg/day during this critical period (Moss, personal communication). Two major studies (Dobos *et al.* 1995; Penno *et al.* 1995) are in progress to determine the incidence of milk depression, due to fatty udders, in heifers fed balanced rations or grazed on pasture. This is likely to be less of a problem with pasture-based rearing systems, particularly for spring calving herds when the critical period occurs in late summer to winter, a period of poor pasture growth.

Larger heifers produce higher yields of milk, but this is at the expense of feed efficiency, as many studies have shown a negative correlation between dairy efficiency (milk yield/feed intake) and measures of body size (McLean 1995a). Heavier heifers cost more to rear, have higher maintenance requirements and may cause greater pugging damage to wet pastures. However, when total herd profitability is considered, several authors have shown it to be more profitable to rear heifers to heavier pre-calving LW (Freeman 1995, Lean 1994, McLean 1994, 1995b, Moran 1995b).

Indices of heifer performance

To determine how well heifers are performing in the milking herd, one good criterion to use is their first lactation milk yield as a proportion of that of mature cows in the same herd. This has increased in Australia from 65-70% in the 1960s to 80-85% in the 1990s (McClyntock, personal communication). State averages over the last 5 years for Friesian herds are 80% in Victoria, 82% in NSW and WA and 84% in Queensland. As an indicator of the potential for heifers to be highly productive in their first lactation, Israeli herd improvement organisations have recorded heifers producing at 90% of that of their mature herdmates, which produce 10,000 L milk per lactation.

THE COSTS AND BENEFITS OF IMPROVED HEIFER REARING SYSTEMS

J. B. MORAN[A] *and D. F. EARLE*[B]

[A]Kyabram Dairy Centre, Institute of Sustainable Irrigated Agriculture, RMB 3010, Kyabram, Vic. 3620
[B]Heiferlink, 400 Wyndham St., Shepparton, Vic.. 3630

Current Australian heifer rearing systems

In 1994, a survey of calf and heifer rearing was completed by 323 dairy farmers who attended a nutrition course in northern Victoria and the Riverina (Moran 1995a). The majority of these farmers (68%) reared their own heifer replacements, either on the home farm or a nearby "runoff' block, while 22% agisted them off-farm (usually paying on the basis of per head per week). A further 10% of the farmers made use of contract heifer rearing schemes, in which payment was based on liveweight gain over a specified period.

More than 90% of these farmers fed concentrates beyond the milk rearing phase, this being a recent innovation in northern Victoria. Only 3% fed concentrates regularly from weaning through to 12 months of age, while 48% fed for up to 4 months, 27% from 4 to 6 months and 14% from 6 to 12 months of age. The low incidence of feeding concentrates between 6 and 12 months of age is of concern because this coincides with slow pasture growth during autumn and winter in Victoria, such that growth rates of unsupplemented heifers may suffer. In other surveys of heifer rearing undertaken in W.A. and N.S.W. (cited by Moran 1995b) and in S.A. (McLean 1995a), many farmers indicated they fed hay to their young stock. As the nutritive value of the hay fed is likely to be less than that of grazed pastures, hay supplements would not improve heifer growth rates unless pasture availability was limiting.

The nutrient requirements of growing dairy replacements

Before planning feeding strategies for growing out heifers, it is important to set realistic target LW for different ages. For example, for Friesian heifers weighing 100 kg at 3 months, a target of 550 kg when calving at 24 months requires an average growth rate of 0.7 kg/day, whereas a target of 450 kg at 24 months or 500 kg at 30 months of age requires an average growth rate of only 0.5 kg/day. Seasonal target growth rates should take into account variations in pasture availability and quality, to ensure supplements are efficiently used throughout the year. Yearling heifers can show compensatory gain in spring following feed shortages the preceding winter. As mentioned above, target growth rates during the critical growth period between 3 and 9 months of age should not exceed 0.8 kg/day. The dry matter (DM) intakes and nutrient requirements for growing heifers are presented in Table 2. As well as energy and protein intakes, dietary calcium and phosphorus levels must be maintained to ensure adequate skeletal growth.

Table 2. Nutritive value of diets recommended for heifers of different ages to grow at 0.7 kg/day (NRC 1989)

	3-6 m	6-12 m	>12 m
Liveweight (kg)	150	254	400
DM intake (kg/day)	3.7	5.7	8.8
Metabolisable energy (MJ/kg DM)	10.9	10.3	9.5
Crude protein (%)	16	12	12
Calcium (%)	0.52	0.41	0.29
Phosphorus (%)	0.31	0.30	0.23

Grazed pasture is usually the cheapest feed available (Moran 1993), so it should constitute the bulk of the diet. Rumen capacity in young heifers does not reach mature proportions until 5 or 6 months of age (Warner and Flatt 1965) and unless pasture quality is high, feed intake and animal performance may be restricted by the size of the rumen. Consequently, high energy supplements are usually required to maintain good growth rates in young heifers. The most difficult periods to ensure acceptable growth rates in spring-born heifers are immediately following weaning and during their first winter.

Traditional heifer rearing systems have relied almost entirely on grazed pasture. However, there is an increasing awareness among dairy farmers that pasture-only diets may not provide the required nutrient intakes for acceptable heifer growth rates except for short periods when pasture quality is sufficiently high, for example during the spring flush of pasture growth. It is common practice in the U.S. to feed grain or conserved forage supplements to grazing yearling heifers (USDA 1992) and many contract heifer rearers in southern Australia have found supplementary feeding necessary to achieve target LW.

Managing grazing heifers

Recommendations for grazing and feeding systems will vary with different regions. Rather than depend on "recipes", producers should use target growth rates to plan optimum feeding strategies. To achieve 550 kg by 2 years of age, seasonal target growth rates can vary between, say, 0.5 and 1.0 kg/day. Young stock should not be allowed to lose weight or grow very slowly for long periods of time during their first year, as they may not achieve their potential frame size or mating LW by 15 months of age. It is also important to plan and undertake routine parasite control, for both internal and external parasites, and vaccinations using regional recommendations.

Pasture mass and quality are the two major factors influencing growth rates of grazing heifers. The main components of pasture quality are digestibility of green herbage, the amount of dead material and the proportion of legume in the sward. The effects of herbage mass of a moderate quality pasture on the predicted DM intakes and growth rates of heifers varying in age and liveweight are presented in Table 3. These have been calculated for temperate pastures using the GRAZFEED computer model, developed by CSIRO (1993). Low pasture masses (1300 kg DM/ha) may suffice for very young heifers in some areas of Australia, but unless they increase to 1800 or 2600 kg/ha or even more for older animals, supplementation will be required to achieve 0.7 kg/day LW gain. Predictions using this computer model can also take into account stocking rates and required levels of supplements to achieve target growth rates.

The best way to monitor the success of feeding programmes for replacement heifers is to regularly weigh them, at least every 3 months. The routine use of chest girth tapes cannot be recommended as they invariably overestimate LW. Most commercially available "weigh" tapes were developed from LW/chest girth relationships using beef cattle which have more compact hindquarter conformation than dairy heifers. In a comparison of 4 commercially available weigh tapes, using Friesian heifers up to 6 months of age and LW up to 240 kg, all tapes overestimated LW by 30 to 40 kg (Moran, unpublished data). Increasing use is now being made of graphs and charts relating heifer LW and wither heights to age, currently based on US industry standards (Radostits *et al.* 1994).

Table 3. Predicted DM intakes and growth rates (in brackets) in kg/day for heifers grazing various herbage masses of moderate quality temperate pasture (70% digestibility, 15 % legume, 25% dead pasture)

Age (m)	Liveweight (kg)	Herbage mass (kg green DM/ha)		
		1300	1800	2600
8	225	6.0 (0.7)	6.7 (1.0)	7.1 (1.2)
10	275	6.5 (0.6)	7.4 (0.8)	8.0 (1.1)
13	350	7.2 (0.4)	8.2 (0.7)	9.0 (0.9)
16	400	7.6 (0.3)	8.7 (0.6)	9.5 (0.9)
20	450	7.8 (0.3)	9.0 (0.5)	9.8 (0.8)

The costs of rearing dairy replacements

The energy requirements and the associated costs of rearing heifer replacements to calve down as 2 year olds either at 450 or 550 kg have been presented in detail by Moran (1995b). These were calculated from feeding standards (NRC 1989) assuming growth rates of 0.55 or 0.7 kg/day from 3 to 24 months of age. The total energy to obtain a 450 kg heifer is 39,490 MJ which, if originating from grazed pasture (3.9 t DM) priced at 0.6 c/MJ, costs $237. The additional energy required to produce a 550 kg heifer (8940 MJ) was assumed to be supplied entirely from cereal grain (745 kg DM) which, if available for $140/t, costs an extra $134. Other assumptions were the value of the calf ($l00), costs of rearing to 100 kg at 12 weeks of age ($120), together with costs for veterinary ($20), labour ($40), mating ($20) and interest on financial input of 10% per annum over 2 years.

The total cost to produce each 450 kg heifer was then $643 and to produce each 550 kg heifer was $804. The effect of higher grain prices on the total costs of rearing each heavier heifer are $832 with grain costing $170/t and $859 with grain costing $200/t. Therefore to produce heifers weighing 100 kg heavier at point of calving costs an additional $160 to $215 depending on grain prices.

Contract heifer rearing

Agisting young stock off-farm has much to commend it as it allows dairy farmers to use all available resources (such as feed, land and labour) to produce milk while still having control over the disease status and the genetic progress of their herd. In virtually every dairying region in Australia, dairy farmers can now make use of contract heifer rearing schemes. These allow farmers to agist their heifer replacements, from as young as 4 months of age, with specialists who contract to grow them out at a pre-determined rate, then return them to the dairy farm just prior to calving. Agreements between dairy farmers and heifer rearers should be carefully written, sometimes with the aid of a consultant as an independent third party. Examples and costings of such agreements have been discussed by Moran (1995b).

For contract rearing to become an integral part of the dairy industry, dairy farmers must have confidence that their heifers can be consistently grown to achieve target LW with minimal health problems. Rearers should be selected on their previous experiences with rapidly growing pasture-fed livestock. Dairy farmers require contract rearers that will feed and manage their heifers to achieve seasonal growth rates of at least 0.5 kg/day, to average 0.7 kg/day over the full year. Heifers will generally require supplementary feeding for several months each year and at high levels (2 kg grain/head/day or more), if the farms are heavily stocked. Any interstate movement of heifers requires health certificates and therefore health clearances and registration by government veterinarians, which are now becoming more stringent in the light of current disease control measures, such as for Johne's Disease and Enzootic Bovine Leucosis.

Many dairy farmers underestimate the costs of rearing heifer replacements on their own farm. Therefore they may consider contract rearing costs excessive. In the total costings calculated above for on-farm rearing of heifers weighing 550 kg at point of calving, feed costs range from $371 to $416, depending on grain prices. The total costs for liveweight gain for 4 contract rearing schemes (Moran 1995b) range from $371 to $527, or the equivalent of $4.50 to $6.50/head/week. When comparing contract rearing with agistment rates, young stock can often be agisted for $3 to $4/head/week, but that does not include any guarantee for pre-determined growth rates.

The net cost for contract rearing can be considerably reduced when dairy farmers increase the size of their milking herd, to make better utilisation of the pasture not required for young stock. For a northern Victorian irrigated dairy farm, O'Farrell (personal communication) calculated this to allow a 2 to 3% increase in milking cow numbers. These dollar savings should be quantified to assist with the decision as to whether to use contract rearers or not.

Economic benefits of heavier heifers

Heavier heifers are more expensive to rear and maintain, but they are more productive than light weight heifers. The obvious question that arises is "Are they more profitable over their entire lifetime, and if so, by how much"? Assuming the net lifetime benefits from rearing heavier heifers to calve at 550 kg as against 450 kg are 2300 L, this should realise a lifetime profit of $240 per heifer. These calculations take into account costs of growing out bigger heifers and their higher lifetime maintenance requirements, as well as feeding them for the additional 2300 L milk produced over 5 lactations. The calculations were based on cereal grain prices of $140/t; higher grain prices would obviously reduce these benefits. For grain priced at $170/t, the net benefits were $177, with grain priced at $200/t they were $111 per heavier heifer.

Such calculations did not account for factors such as higher genetic returns in the herd arising from greater selection pressures on replacement heifers, as only 27% of the heavier animals needed to be replaced every year as against 33% for lighter animals. Heavier heifers will conceive more readily, leading to a tighter calving pattern, and should have fewer calving difficulties. Heavier heifers produce heavier calves which grow faster and have fewer health problems in their first few weeks of life (Moran 1993), requiring less labour during the calving and early rearing periods.

Until they can be fully verified, the above assumptions suggest that profit margins are at least $240 per heifer when reared to calve down as 2 year olds weighing 550 kg as against 450 kg. These calculated profits are slightly less than the $187 per heifer calculated by McLean (1995b) for the lifetime net benefits when reared to calve down 50 kg heavier, at 550 kg compared to 500 kg LW; in this case McLean (1995b) assumed heifers would yield the equivalent of an extra 3000 L milk (over 5 lactations) per 100 kg heavier calving LW. One should bear in mind that other studies (eg Valentine *et al.* 1987) have shown much lower benefits in terms of increased milk production. These actual net lifetime benefits also depend on how well the milking herd is fed, as Australian published data on first lactation milk yields varies from a low of 4 L (Freeman 1993) to a high of 13 L (Moss *et al.* 1996) for each additional kg in calving LW.

There are also economic benefits for year-round milk producing herds in growing out their heifers at faster rates to reduce age at first calving. One W.A. study (cited by McLean 1995a) showed a saving of $330 per heifer by reducing age at first calving from 33 to 27 months, while a second study showed farm profits of up to $30,000 through a reduction in age at first calving from 30 to 24 months.

Eighty five per cent of farmers in the 1994 northern Victorian survey reported calving difficulties with their first lactation heifers, while 35% culled some of these heifers because of poor fertility and/or poor production (Moran 1995a). As heifers represent the most advanced genetics in each dairy herd, any premature culling represents a wastage of their investment. This alone should justify the current interest in improved heifer rearing systems on Australian dairy farms.

THE PROJECT 21 TECHNICAL INFORMATION PACKAGE ON IMPROVED CALF AND HEIFER MANAGEMENT

R. JOHNSTON[A] *and R. BUESNEL*[B]

[A]SW Agriculture, PO Box 108 Gloucester, N.S.W. 2422
[B]NSW Agriculture, PO Box 53 Bega, N.S.W. 2550

A large amount of information has been compiled in Australia and overseas on improved calf rearing systems, heifer rearing management and disease control. Unfortunately much of this information has been dispersed in small isolated chunks and generally in an *ad* hoc manner. A co-operative effort between NSW Agriculture and Agriculture Victoria is being developed to promote cost-effective feeding and rearing systems for dairy heifers.

Assistance is being received from the Dairy Research and Development Corporation, through Project 21 in N.S.W. and Target 10 in Victoria, as well as from agribusiness, veterinarians and government advisory officers.

The process

A consultative group was initially established to investigate ways of improving delivery of information on calf and heifer rearing. The group focused on target issues of:

1. Good colostrum feeding management
2. Weaning weight at 12 weeks of age
3. Live weight and/or age at first calving
4. Minimising stress and optimising health
5. Economics of rearing systems.

Initially the group consulted with a wide range of farmers and agribusiness people through a survey on problem areas and how best to deliver the most relevant information. A workshop was conducted in March 1995 to outline the results of the survey, with key people involved in providing products and information on heifer rearing.

The technical information package

Industry support is essential for promotion of better rearing and management systems. With this support the group is developing a package which includes:

1. A commercial video entitled "Caring for calves" released in August 1995. This video presents current technical knowledge together with aspects of empathy required for good calf rearing. Such information should allow dairy farmers to provide their heifer calves with a "good start" to life with the aim of ensuring acceptable growth rates to reduce their ages at first calving and/or achieve target LW when calving down as 2 year olds.
2. A series of 15 laminated cards on various aspects of calf and heifer rearing practices. These cards have been designed as "stand alone" information packages that can be kept in the dairy or calf shed, produced on "How to" topics such as stomach tubing calves, identifying sick calves, feeding for early weaning, monitoring heifer LW and assessing feed quality.
3. A kit for both farmers and industry detailing the current sources of available information.
4. A series of farmer/industry information meetings throughout N.S.W. and Victoria. These meetings will initially be "Training the trainer" workshops specifically for agribusiness, veterinarians and other suppliers of information for dairy farmers. These will then be followed by a series of field days for dairy farmers and contract calf and heifer rearers.
5. A second video on heifer management from weaning to calving has been planned for 1996.

Industry has acknowledged the vital role of better calf and heifer rearing. Working together in the development of the package has provided a commitment and ownership to ensure delivery of the information.

CONCLUSIONS

J.B. MORAN

Kyabram Dairy Centre, Institute of Sustainable Irrigated Agriculture, RMB 3010, Kyabram, Vic. 3620

The full costs of raising replacement heifers are a substantial portion of the overall costs of milk production, perhaps second only to the cost of feeding the milking herd. This enterprise can account for 15 to 20% of the total milk production costs in the U.S. (Radostits *et al.* 1994), so it is important for producers to quantify them. Farmers generally underestimate calf mortality rates and tend to rank calf disease low in economic importance. Well bred dairy replacements have the highest genetic potential of any animal in the herd and are a key asset for increasing the production and efficiency of milk and hence the herd profits. The production potential of heifers is a result of all previous breeding and management decisions. The roles of dairy advisers and veterinarians are to provide producers with sufficient information to understand the principles of calf and heifer health and production, so as to adopt recommended practices resulting in healthy calves that grow at acceptable rates so as to become economic contributors to herd profitability.

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