THE VIABILITY OF MILK PRODUCTION IN PASTURE-BASED SYSTEMS

Kevin Macdonald

INTRODUCTION

Throughout the world there is an increasing interest in grazing production systems, primarily a result of expected volatility of milk prices and returns in many countries due to: the proposed removal of subsidies in Europe, costs associated with housing cows, labor and feeding of total mixed rations (TMR), and the perceived environmental and animal welfare concerns associated with intensive dairying (DILLON et al., 2005). In New Zealand (NZ), Australia and many parts of Western Europe and South America, pasture is the major feed of the cow for long periods of lactation. In NZ, farming systems have evolved to capture seasonal pasture growth by adopting a compact calving period in spring, just prior to the flush of spring pasture growth, in an endeavor to match the supply of pasture and the herd’s demand (BRYANT, 1986).

The NZ industry produces 2.5% of the world’s milk production and accounts for approximately 33% of the international milk traded. Dairy export values contribute 28% to NZs total merchandise export earnings. As such a high proportion of the milk produced in NZ is exported in the form of milk products and farmers are reliant on the international market as little (<5%) of the milk produced is used domestically. As the milk is manufactured into products, payment to farmers is based on milksolids (MS; milkfat and protein), not whole milk (liters of milk). Due to the fluctuating international milk price, to remain internationally competitive, the cheapest food source is used. This is generally grazed pasture.

Pre-2000, NZ farmers had the lowest cost of milk production of the major milk producers. This advantage has been eroded and now Argentina, Brazil, Ukraine and several others are able to produce milk more cheaply. As NZ exports nearly all its milk, it is essential that NZ dairy farmers maintain a low cost production to be able to take advantage of the increasing international demand for milk products.

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Features of what makes a grazing system profitable are presented in this paper rather than the economics of the system. The changes in the NZ dairying system in terms of feed offered to the cows and breed of cow milked are also discussed.

**DAIRYING IN NEW ZEALAND**

Traditionally, New Zealand dairy farmers have relied on their ability to produce MS cheaply. This has been the competitive edge they have always had, but in the last 15 years there has been a wide range of dairy production systems evolve in New Zealand. This has occurred because each farmer has their own definition of success, set of values, skills, knowledge and aspirations, and have different resources available to them (HEDLEY et al., 2006). There are now a range of farm systems in NZ compared with the ‘traditional’ pasture only system. The change is such that in the 10 years from 2000 to 2010 there has been a change from 17% to 35% of farmers who now import between 15 and 30% of the feed supply (Figure 1).

Figure 1. Change in farm systems in New Zealand based on percentage of feed imported into the farm on an annual basis. Low <15%, Medium 15-30% and High >30% (source DairyNZ Economics unit).

Dairy systems in New Zealand aim to maximise pasture growth and ensure that most of the pasture is eaten by the herd (high utilisation). Adequate soil fertility, drainage and productive species are essential to maximize growth. Pasture utilization is about having the right stocking...
rate to ensure there are enough cows to eat all the available pasture. The role of supplementary feeds is to add energy during periods of pasture deficit so that cows maintain energy intake and production. This statement can sum up the situation: “Anything which you put between a cow and a blade of grass has to be paid for by the cow!”

About 60% of New Zealand pasture production occurs in the five months from September to January. To ensure maximum use of this feed, NZ farmers’ operate a seasonal calving pattern, with the planned start of calving in late winter and an 8 to 10 week calving spread. The calving date of the herd sets the pasture demand so this needs to be such that it ensures adequate feed for the cow. Calving too early may mean the need to purchase costly feed and calving too late will create difficulty in maintaining pasture quality through an overabundance of feed. Calving in the North Island generally will start in July, but with later and slower growth in the South Island (latitude) it will be in August.

New Zealand dairy pastures are dominated by perennial ryegrass mainly because it grows in a wide range of conditions and is easy to establish. Added to this, the plant is easy to establish and has a high digestibility capable of supporting high levels of animal performance. Pasture growth in NZ varies but in ideal conditions the “physiological limit’ estimated by Mitchell (1963) is 19 t DM/ha in Southland to 28 t DM/ha/yr in Northland. It is doubtful if these levels are achieved on farms but certainly 18-20 t DM/ha/yr can be achieved on research farms (MACDONALD et al., 2008; MCGRATH et al., 1998).

Ryegrass plants are made up of several tillers each maintaining up to three live leaves at any one point, meaning leaves have a limited lifespan. Ryegrass leaves originate from a growing point near the base of the plant and seldom does this growing point get removed by grazing. While new leaves are continually produced, each time a new leaf appears the oldest leaf on that tiller dies (HUNT, 1965). Therefore, the appearance of new ryegrass leaves and death of existing leaves are closely related. Fulkerson and Donaghy (2001) suggested that grazing pasture older than 3 leaves/tillers will not only lead to wastage of pasture but also senescent material will reduce overall quality of herbage. Rate of leaf appearance matches pasture growth, thus it is fastest in spring (7 days) and slowest in winter (30 days). Due to the close relationship between appearance and death the life of a leaf/tiller is approximately 21 days in spring and up to 90 days in winter. Therefore grazing management should be manipulated to ensure survival of the pasture and maximising utilization.
THE GRAZING MANAGEMENT PERIODS

There are four important grazing management periods. They are:

1. **Autumn-Winter.** From the time of drying off the herd (March-June) through to the start of calving (July). The basic aim in this period is to build up and then maintain sufficient pasture mass to feed the herd after calving while ensuring cows calve at an average body condition score (BCS) of close to 5.0 (10-point scale; MACDONALD and ROCHE, 2011). The New Zealand cows that are being milked today are of high genetic ability and will continue to milk at the expense of body condition. Therefore, it is necessary to dry them off early enough to achieve the BCS target or they will need to be supplemented.

2. **Early Spring.** From the start of calving (July-Aug) to when pasture growth exceeds the herd demand (Sept-Oct), it is important to use a spring rotation planner (DAIRYNZ, FARM FACTS, 2014) to control pasture intake in order to meet target pasture cover at balance date (when pasture growth exceeds herd demand). This is something that will only be achieved provided the grazing rotation is not sped up and pasture growth restricted by too frequent grazings.

3. **Late Spring.** The period when pasture growth exceeds herd demand (Oct to Nov). During this period the essential requirement is to provide high quality pasture to the herd. The pasture fed to the herd must be young and leafy. Once the stem-to-leaf ratio increases and seedheads appear, the digestibility and metabolisable energy (ME) content of the pasture rapidly declines. Any pasture surpluses should be harvested as silage.

4. **Summer.** When pasture growth depends on rainfall (Dec-Feb). Without irrigation this period is highly dependent on summer rainfall. Pasture growth during summer/autumn is unpredictable and generally the safest management is to maintain the late-spring grazing rotation. If the rotation length is altered it should be lengthened rather than shortened.

LOOKING AFTER PASTURES

Hendricks et al. (2007) described the fundamentals of pasture management for maximum production as follows:
The fundamentals of grazing management are those that maximize the amount of ME harvested. To maximize the amount of pasture grown, soil damage (pugging) should be minimized, pastures grazed when ryegrass tillers support between 2 and 3 leaves, pasture mass kept above 1800 kg DM/ha, and a fertilizer policy applied that supplies enough nutrients to maintain the required pasture growth (use of nitrogen at strategic times).

- Measure and monitor pastures. The quantity of pasture needs to be regularly monitored. When the amount of pasture available is known it can then be manipulated by using grazing rotation lengths that are closely related to pasture growth; short rotations at times of rapid growth and long rotations during slow growth. Monitoring of pastures will also help inform decisions around supplementation and removal of surpluses.

- Harvest the feed grown by removing all the highly digestible pasture at each grazing. It is important to graze or mow to constant residuals.

**PASTURE SILAGE MAKING**

As the pasture silage crop matures, yield is increased but the metabolisable energy (MJ ME/kg DM) decreases. A delay in harvest from 7 to 9 weeks increased yield by 20% but quality declined from 10.8 to 10.3 MJ ME/kg DM (MCGRATH et al., 1998). Therefore, a trade-off exists between DM yield and the energy content of that DM. Recommendations from recent work are that as long as the post-grazing residuals are even and about 1500-1800 kg DM/ha then the crop will mature evenly. If the residual is uneven with lots of clumps, at harvesting the quality will be variable throughout the paddock.

The question is often asked “When is a silage crop ready for harvest?” The answer is generally when 10% of the crop has seed head. The problem with this answer is that when the silage is actually harvested can be 1 to 2 weeks later than the 10% seed head stage, depending on the farmer’s organisational skills, weather and availability of a contractor (if used). In this time the silage crop will drop in quality from being good to marginal. Therefore, it is imperative that farmers are proactive with decision making on when a crop is to be harvested. If a crop is ready to be harvested it is essential that this can occur. Planning needs to be made well in advance of when the crop is ready for harvesting. Making silage is costly and if the silage is to be fed to
lactating dairy cows and to assist in extending lactation into the autumn, then it is vital that high quality silage is conserved.

**STOCKING RATE**

Stocking rate (SR) sets the pasture demand and is core to a successful system, in that too high a SR may mean underfed cows or too low may lead to under-utilisation of pasture leading to the cows being offered poor quality feed. Pasture eaten per hectare is an important component of successful farm management, but it is often forgotten in an attempt to maximise per cow intake. The amount of pasture eaten is also dependent on the weather due to variations in seasonal pasture growth and the amount that can be utilised by the cow. A major factor at any SR is the amount and distribution of pasture production which is driven by climate. In any locality there is the potential for a large variation in daily pasture growth between years. Any variation in feed supply from the norm must be planned for. The effects of shortfalls are greater as SR increases.

Observation of grazing residuals as an indication of feed surpluses is useful to determine the potential of the farm to change SR. The Lincoln University Demonstration Farm (LUDF) increased SR based on observation of the farm being in surplus, not on measurement of pasture grown. As in the trial run by Macdonald et al. (2008), LUDF found that pasture grown increased with increasing SR. As SR increases it is more important to plan so constant monitoring of feed supply by farm walks is essential.

As SR is set at the start of winter, the feed available per cow for some farms can vary greatly between seasons, therefore, there is no recipe to set the SR for any given year. To manage the seasonal variation requires planning, the appropriate infrastructure on the farm and a set of decision rules that govern pasture management to achieve the critical factors for a sustainable system (average pasture cover at calving, cow condition at calving and mating).

A high SR farm may need to dry-off early but a low SR farm will need to ensure maximum days in milk and this will require that the appropriate feed is in place at a price that makes the system profitable.
Macdonald and Hedley (2010) presented a set of rules that govern basic farm management at a range of SR. An example of this is the pasture cover required to feed the herd increases as SR increases. Also the use of culling will generally be required earlier at a high SR compared with a low SR. Thus it is essential to have systems in place to reduce risks to any business. It is all about planning and knowing what you want to achieve and having the ability to get there.

SUPPLEMENTS AND CROPPING

The role of supplements is to add energy during periods of deficit, contributing to an increase in total MS production. The use of supplements can improve pasture utilisation because it gives the confidence to increase grazing pressure through increases in stocking rate. This ensures that pastures are always in a leafy and rapidly growing phase. Supplements can also be used to grow more pasture by maintain grazing residuals and allowing the rotation to be extended at key times. High levels of pasture utilisation are essential to high MS per hectare production systems that generate high levels of economic returns.

In NZ in recent years, particularly in the North Island there have been summer droughts (Feb to Mar) which have left cows short of feed. This has influenced farmers to grow crops such as turnips and in some cases farmers have overcome this by buying Palm Kernel Expeller (PKE). Palm kernel expeller is a by-product of the palm oil industry in South East Asia. It is derived from the nut of the palm fruit after the oil is either mechanically extracted (most PKE imported to NZ) or solvent extracted (lower nutritive value). It is has reasonable levels of energy (11.0 -11.5 MJ ME) and protein, and is relatively easy to introduce to cows over a range of farm systems. The profitability of PKE as with all feeds is dependent on the price of PKE relative to milk price and the utilisation of PKE and pasture and milk yield response. Generally the more feed required to make up the deficit then the greater the milk yield response will be.

As one single pasture mix (ryegrass and clover) is rarely likely to supply the seasonal distribution required in a pasture based system, farmers have also been growing herbs such as chicory and plantain to increase feed supply during periods of low pasture growth, e.g. summer. Brassica crops also can supply high quality feed when required. Most farmers will now fit these crops into a pasture renewal programme.
The other main supplements used are maize silage in the North Island and winter crops of kale and fodder beet in the South Island. Maize silage is readily available and easy to trade, store, and feed. However, it is often suggested that the lack of protein in maize silage may limit production, particularly in the summer when pasture crude protein (CP) levels can drop to less than the required 16-18% for lactating dairy cows. Macdonald et al. (1998) investigated the ability of urea, soybean meal, and fishmeal to overcome protein deficiencies that occur when cows are supplemented with large amounts (>30% of diet) of maize silage. Fishmeal and soybean meal increased both MS yield and bodyweight gain in the summer and autumn. Urea did not increase MS yield and also the inclusion of urea carries the additional risk of animal health problems due to urea toxicity. Good quality pasture silage or alfalfa silage can also be used as sources of CP. In the South Island, kale and fodder beet are generally grown off the milking platform, either on a run-off block or on a dry stock unit. Both of these crops will supply feed in the winter which is a critical period of low or no pasture growth, thus pressure is taken off the grazing platform.

In using supplements, farmers have to consider the cost of this feed and also what response they will get from it. The response they may get is determined by six factors:

- Size of the feed deficit.
- Quality of the supplement.
- Quality of the pasture.
- Level of substitution.
- Stage of lactation.
- Cow condition.

### SIZE OF FEED DEFICIT

Thomson et al. (1997) recorded a response of 115 g MS/kg DM from barley grain fed in the spring when cows were being underfed on pasture, and Clark (1993) showed that when large feed deficits are created, such as with high stocking rates, then large responses to supplements can occur. But even in a controlled situation (as in a trial) it is difficult to predict what response to supplements will be achieved and between years variations do occur. For example, Thomson et al. (1998) demonstrated that in the first year responses of 76, 32 and 66 g MS/kg DM
supplemented were achieved in the spring, summer and autumn, respectively, but in the second year much better responses of 157, 82 and 179 g MS/kg DM were achieved.

QUALITY OF SUPPLEMENT

It is important to recognise the limiting factor on the farm in terms of increasing production and profitability. In New Zealand dairy farm systems, energy is usually the primary limitation so it is important that the cheapest form of energy is purchased. Increasing pasture silage quality from 8.1 to 10.5 MJ ME/kg DM (a 20% difference in feed quality) gave increases in milk and MS production of 13%, 17% and 41% in the spring, summer and autumn, respectively (MACDONALD et al., 2000). For maximum economic responses, the supplement quality is of paramount importance particularly when offered to cows grazing low quality pasture as is possible in summer and autumn.

QUALITY OF PASTURE

Generally, the higher the quality of the pasture then the lower will be the response from supplements. Therefore in times of poor quality feed (as in a dry summer) larger responses can be expected, but this has often not been the case when supplementing with an ‘energy source’ as energy may not be the only limiting factor (CLARK, 1993). In summer, energy is not the only limiting factor as pastures can be low in CP (10-12%) and feeds such as maize silage will not be of benefit as its CP is often less than 6% at a stage when the cow requires 14-16% CP in the diet.

LEVEL OF SUBSTITUTION

Extra feed inputs can cause various amounts of additional milk production, pasture substitution and changes in body condition. Substitution is where a cow fed a supplement reduces its level of pasture intake. The level of substitution is directly related to the total allowance. The higher a cow’s intake without supplementary feed, the greater the level of substitution when extra feed is offered. The increase in milk production that occurs within a few days of starting to feed supplements is known as the “immediate response”. Over a longer period, extra milk may be
produced as a result of improved cow condition or better pasture mass attained because of substitution; this is known as the “carry-over effect”. Typically, the carry-over effect is equal to, or greater than, the immediate effect. However, this is dependent on the subsequent utilisation of any spared pasture and cow condition.

Spared pasture will only be utilised if the feed deficit period continues until the herd returns to graze the particular paddock that was grazed at the time of supplementary feeding. Therefore, cow condition spared by supplementary feeding will be of little benefit if generous feeding would have otherwise allowed any lost cow condition to be replaced shortly after tissue was mobilised.

**STAGE OF LACTATION**

In a number of New Zealand trials, the largest response to supplementation was achieved in the autumn by increasing the length of the lactation. This production response is attributable to the marginal feed input above that required for maintenance. It is important that when the feed cost is subtracted from the extra milk income a profit has been generated. Any additional labour costs that will be incurred also need to be included.

Clark (1993) reported the responses and carry-over effects of feeding pasture silage to dairy cows at different times of the year. Small immediate responses of 26 and 16 g MS/kg DM occurred in spring and summer, respectively. Carry-over responses of 46 and 45 g MS/kg DM were measured between the conclusion of the spring and summer silage feeding periods and the end of the season. These large carry-over effects were generated because the additional cow condition and pasture cover were able to be utilised, mainly because of the high stocking rates that created large feed deficits. The 66 g MS/kg DM immediate response measured in the autumn was twice as large as immediate responses measured in spring and summer. Feeding pasture silage in the autumn extended lactation by seven days.

Macdonald (1999) reported that the largest response to groups being supplemented for most of the year was achieved in the autumn as by a longer lactation. This production response was attributable to the marginal feed input above that required for maintenance.
COW CONDITION

Attaining a high level of production early in lactation is essential because this determines the overall lactation yield, but only if the cows are then well fed. To attain high production in early lactation the cows need to be at BCS 5 at calving on a 10-point system (3.1 on the US 5-point system; Roche et al., 2004). If the cows are above BCS 6 at calving they will eat less in the first eight weeks and conversely if lower than BCS 5 they will eat more. Some of the increased intake with low BCS cows will be partitioned towards body condition gain at the expense of early lactation milk production.

The objective of autumn management is to increase average farm cover while ensuring cows reach BCS 5 by 1 June. Adding purchased feed must not compromise these objectives. In fact, pasture and grazing management should be as if purchased feed was not available. That is to say, grazing rotations should offer the same pasture area as would have been offered had supplementary feed not been available. The additional feed can be used to help slow the rotation and ensure that the cows are adequately fed as well as having a longer lactation. This action must not be at the expense of lowered pasture cover or lost cow condition.

THE IDEAL COW

Cows grazing pasture require different attributes to those being fed TMR. Farm profitability under a pasture based system is maximised at relatively high stocking rates producing high yields of milksolids per hectare (MACDONALD et al., 2011) so the cows must be efficient converters of pasture to milk.

Cows derived from differing management systems have been selected for differing characteristics and ability. Cows on pastoral systems will spend up to 10 hours a day grazing to consume 15 to 20 kg DM, whereas those fed on a TMR need only about five hours to consume 20 to 25 kg DM. Linnane et al. (2004) (Ireland) compared NZ and North American (NA) Holstein Friesian (H-F) cows at pasture and found the NZ cows grazed for longer and that they were adequately supplied with nutrients on a pasture-only system, whereas the NA cows required a high level of concentrate supplementation to achieve their full genetic potential. Similarly, Rossi (2006), in a NZ study, demonstrated that the NZ type of cow is able to consume more
pasture; but the NA cow required a leafier and higher pre grazing mass before intakes and production was greater than that of the NZ cow. This has implications in that, in providing this leafy and longer pasture, the sward has to have a low post-grazing mass which will restrict intake and lower production, otherwise the pasture quality available at the next grazing is compromised. In both these trials the NZ cows had a higher DM intake per kg bodyweight.

Pasture fed cows may walk 3-8 km per day whereas a feed-lot cow will have minimal walking. Thus the ability to walk is essential for pasture based cows and this is not just based on the legs, it also is imperative that the udder is not so pendulous that it will affect normal leg movement.

A pasture based system needs to fit around pasture growth with little growth in the winter and surplus feed available in spring. Thus, cows must calve to eat the grass and they must conceive every 365 days to do this. In a feed-lot it does not matter when the cow calves and there may be long intervals (>420 days) between calvings.

Due to the variation in feed supply, pasture based cows may be restricted in feed supply at periods where the feed-lot cow is rarely restricted in intake. Thus, to capture the potential from the cow a feed-lot cow may be milked two or three times a day. In a pasture based system the cows generally will be milked twice a day and occasionally only once a day.

These factors mean that the animal of choice for New Zealand must be mobile, able to graze pasture effectively and get in calf every 365 days. The NZ dairy industry has seen the dominance of breeds and breeding objectives change over the past 60 years to arrive at the modern NZ dairy cow. New Zealand’s original dairy cows were derived from Shorthorn cattle, used for dragging logs out of the forests about 150 years ago. The first Jerseys arrived in the country in the 1860s, when butter was already being exported. It was not until the after the introduction of artificial insemination in the 1950s that Jerseys replaced the Shorthorn as the dominant breed with H-F in turn replacing the Jerseys about 25 years later. Trials comparing Jersey and H-F have shown that the two breeds are comparable in terms of economics (AHLBORN and BRYANT, 1992; PENNO et al., 1998). Data derived from LIC Farm Statistics (2011-12) show that average MS production for Jersey is 48 kg lower than that for the H-F but when comparing the two breeds on kg MS/kg bodyweight the Jersey is more efficient (Table 1).

In the last 40 years there has been a lot of discussion as to which breed is best suited to New Zealand’s conditions. Seasonal dairy production systems require efficient reproductive
processes, and concern has been expressed regarding the suitability of high genetic merit H-F cows for such systems, due to increased feed requirements and their lower level of reproductive performance (DILLON et al., 2003). Companion trials in NZ and Ireland have shown that the NA type of cow does not have the ability to fit the New Zealand and Irish dairy system with respect to its ability to maintain a compact calving interval and to produce milk successfully and profitably under their respective pasture-based feeding systems. Furthermore, the high genetic merit dairy cow of the future will likely have a significantly greater nutrient demand than at present.

<table>
<thead>
<tr>
<th></th>
<th>Jersey</th>
<th>Crossbred</th>
<th>Holstein Friesian</th>
</tr>
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<tbody>
<tr>
<td>Yields (kg) Milk</td>
<td>3120</td>
<td>3930</td>
<td>4410</td>
</tr>
<tr>
<td>Fat</td>
<td>175</td>
<td>193</td>
<td>193</td>
</tr>
<tr>
<td>Protein</td>
<td>129</td>
<td>152</td>
<td>161</td>
</tr>
<tr>
<td>Milksolids (Fat + Protein)</td>
<td>304</td>
<td>345</td>
<td>354</td>
</tr>
<tr>
<td>Milksolids %</td>
<td>9.8</td>
<td>8.8</td>
<td>8.1</td>
</tr>
<tr>
<td>Body weight</td>
<td>376</td>
<td>434</td>
<td>468</td>
</tr>
<tr>
<td>Kg Milksolids/Kg Body weight</td>
<td>0.81</td>
<td>0.79</td>
<td>0.76</td>
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</table>

Footnote: Crossbred = Holstein-Friesian/Jersey cross bred

Both trials (NZ and Ireland) have shown that the NA cow has a propensity to lose body condition post-calving and will remain at a lower BCS for most of lactation and have lowered fertility impacting on a seasonal 365-day calving pattern. Both these factors make this type of cow economically unsustainable under a pasture-based system.

One of the reasons for the high usage of NA semen in NZ in the 1990s was the fact that the Breeding Worth calculations did not include important traits such as BCS, bodyweight and reproduction. Since then, there has been further development of the New Zealand national breeding indices/goals towards the selection of the most suitable animal for pasture-based systems. Breeding Worth (BW) is a ranking system (AEU, 2011) based on expected genetic ability to breed profitable and efficient replacements, and relates mainly to cow progeny. The BW ranking is based on cow ancestry, her own lactation performance, and progeny information.
for 7 traits: production of milk protein, fat, milk weight, somatic cells, BW, fertility, and residual survival (longevity), all of which are combined with specific economic values to derive a breeding worth (AEU, 2011). These traits are combined, and the breeding worth is expressed as net lifetime income ($NZD) per 5 t of DM feed required. This value is increasing for the national herd, consequent upon sire selection, evaluation of daughters by herd test, and use of artificial breeding. Use of Breeding Worth (NZ) will help identify those animals with good fertility and productivity desirable in pasture based-systems. It is important to use systems that identify the animals best suited to the conditions and system within the country where they are to be used. Thus, cows are being matched to the system and not system to the cow.

Clearly, if the NA type of cow is to be a part of the NZ dairy herd, modifications to management are required to maximise the productivity efficiency and profitability of the system. This means a change from the traditional pasture-based into a more intense supplementary or TMR type of feed.

Early comparisons (CAMPBELL, 1977) as to the effect of changing from Jersey to H-F by using a crossbreeding policy showed that the crossbreds produced slightly more milkfat per cow than the Jersey contemporaries (5%) but the old Jerseys in the crossbred herd were penalised so that the whole-herd milkfat productions were consistently similar milkfat/cow. It was concluded that crossbreeding resulted in no herd advantage in production per hectare during the transition stage in changing from Jersey to H-F stock. But, crossbreeding exerts large, positive effects on a national herd (HARRIS et al., 2000) in benefits on increased milk production, reproduction, health and survival. The use of crossbreeding can lead to economic advantages (LOPEZ-VILLALOBOS et al., 2000) but there is always a problem of maintaining heterosis within the herd. The availability of semen from cross-breds, through LIC (known as “KiwiCross™”), has increased the acceptance of crossbreeding and is part of the reason for the rate of increase. Traditionally crossbreeding was used as a way to maintain the MS% or the size of the animals. With the availability of KiwiCross™, and the fact that some of the sires have an extremely high BW, makes cross-breds a very attractive option. Table 2 shows how the NZ national dairy herd has changed from about 15% to over 40% being crossbreds in the space of 20 years. The crossbred animal in NZ has a higher fertility and with increasing emphasis on the need to improve fertility within the NZ national herd there will be an increased usage of crossbred semen or farmers will continue with their own system of maintaining a crossbred herd.
Depending on the perceived failings of the local animal, crossbreeding can also be used to improve areas such as a cow’s fitness (MCALLISTER, 2001) or where there is a requirement for a cow with a particular trait e.g. milk to produce a higher cheese yield (VANRADEN and SAUNDERS, 2001), tick resistance or some other aspects like micro milk components or nutraceuticals.

Table 2. Change of breed composition in NZ dairy herds from 1992-93 to 2012-13 (derived from NZ Dairy Statistics).

<table>
<thead>
<tr>
<th>Breed Composition</th>
<th>1992-93</th>
<th>2002-03</th>
<th>2012-13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holstein-Friesian/Jersey cross bred</td>
<td>15</td>
<td>24</td>
<td>42</td>
</tr>
<tr>
<td>Holstein-Friesian</td>
<td>54</td>
<td>53</td>
<td>37</td>
</tr>
<tr>
<td>Jersey</td>
<td>20</td>
<td>15</td>
<td>12</td>
</tr>
<tr>
<td>Other</td>
<td>11</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

Footnote: Other = Other breeds e.g. Ayrshire, Guernsey, Brown Swiss

CONCLUSION

The NZ pastoral grazing system is based on the premise that pasture is the cheapest feed source. Grazed pasture has a requirement of maintaining quality with the consequences of lower production per cow compared with what farmers might achieve in a feed-lot system. There are variations in pasture feed supply and quality and the farmer has to adapt to meet these. Farmers’ have progressively altered the all grass system to a mixture of grass, cropping and bought in supplements. Along with the change in system there have over the last 80 years been changes in breed of choice for the Jersey to a Holstein-Friesian and now a crossbred.

These changes have demonstrated the farmers’ ability to alter the system they operate on the farm as well as cow type to meet the challenges/demands of climate or market. This demonstrates that the system is forever changing and there should be a continued viability of the NZ pastoral dairying system.
Farmers need to make sure that the type of cow bred is of high genetic ability and suits the farm and system. It is essential that the sires used have been evaluated in the environment in which their progeny are going to be farmed and those evaluation systems value traits that are essential in your system.

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