Moorepark Dairy Levy Research Update

Tuesday and Wednesday, 19 & 20 January, 2010
Moorepark Dairy Production Research Centre
Greenfield Site Open Day, Kilkenny

Series No. 12

Teagasc New Milk Production Programme

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Teagasc New Milk Production Programme

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Despite the current milk price and climatic difficulties, the outlook for the Irish dairy sector in the medium term is positive due to projected significant growth in world demand for dairy products based on increasing world population and a return to improved global economic circumstances. The removal of EU market supports and the abolition of milk quota by April 2015 is anticipated to result in a significant increase in Irish milk production through expansion on existing family farms in addition to new farm conversions from alternative enterprises. This will, for the first time since the early 1980s, enable Irish producers to increase production without incurring additional milk quota costs. There will be significant opportunities for Irish dairy farmers to profitably grow their farm businesses; however, it is only those who fully capitalise on the inherent competitive advantages associated with grass growth and utilisation that will benefit most in this deregulated production environment.

In this scenario, increases in efficiency and scale at both farm and processing level will be important. At farm level, this will necessitate the adoption of key technologies which include compact calving, higher stocking rates, increased numbers of high EBI replacements, high quality pasture management and low cost labour efficient farm infrastructures.

The Teagasc New Programme

The removal of milk quotas is anticipated to result in a significant increase in Irish milk production. This increase in milk production will be realised on existing family farms in addition to new farm conversions from alternative enterprises. One of the ten priority actions identified in the Teagasc Foresight 2030 report was to 'Provide a leadership role in the context of an expansion in milk production'. In 2009, Teagasc set about developing a new project in dairying in conjunction with key stakeholders in the dairy industry. The key objectives of the project are to provide family dairy farms, who intend increasing in milk production, with the necessary skills and technologies to deliver satisfactory financial return to the resources employed. The programme will encapsulate different models of expansion each incorporating low cost, high productivity grass-based technologies. They include:

(1) Existing family dairy farms
(2) New entrants to dairying
(3) New Greenfield dairy unit

(1) Existing family dairy farms

The predominant model of expansion for the foreseeable future will be from existing family-run dairy farm units. On the basis of a case study of such situations, two commercial family-owned farms have been selected to demonstrate how to maximise financial returns on capital employed within the family farm model. The farmers involved have agreed to allow their farms be used to facilitate this work programme over an initial period of five years. The farms identified are reflective of the National dairy farmer population with regards to current land area farmed, land type, scale and farmer intentions regarding business growth. Over the next five years, Teagasc will provide intensive technical support to these two farm families. The farmers have agreed to implement all aspects of the mutually agreed five-year plan incorporating all the on-farm investments necessary to accommodate the scale growth planned. All such investments are financed exclusively by the farmer in a realistic, well structured and manageable manner.

The first farm is a typical family dairy farm that has been handed down through several generations. The farm owner is in his early thirties, married and in full ownership of the farm. This farm is located at an altitude of 700ft in the foot hills of the Knockmealdown mountains. With soils of a peaty nature, it is a wet farm with a low level of development, poor drainage and in an area of high rainfall. The current farm operation is a totally devoted dairy enterprise. The farm business has been slowly expanding in milk production in recent years and is currently milking 65 cows. The farm owner wishes to increase to 100 cows within his current land base as a one person operation. The second dairy farm is similar to the first having been handed down through several generations. The farm owner is in his early thirties, married and in full ownership. The farm is located in south-Tipperary with free draining Acid Brown Earths soils. The farm is run as a typical family farm with assistance from his father and an occasional casual part-time person. The non-dairy land is used as a beef enterprise which has been reducing over the last five years and will cease this year. The farm owner wishes to increase from the current 110 cows to approximately 200 cows.

For the duration of this five-year project (2010-2015), both dairy farms will have access to sufficient milk quota to facilitate a phased, planned expansion of their dairy enterprises by means of a licence by the Department of Agriculture, Fisheries and Food (DAFF). A detailed five-year development and business plan is being developed for each of the two farms. Both dairy farms require significant investment in milking farm infrastructure (milking facilities, farm roadways, re-seeding, and drainage) and livestock. This infrastructure investment and any increase in stock will be funded by the farmers from their own financial resources. Both dairy farmers will implement key technologies on their respective farms in terms grassland management, animal breeding and financial management.

In return for the intensive advisory effort supplied by Teagasc, the information generated on these two farms will be made widely available for extension purposes to all dairy farmers across the country. Teagasc will manage the dissemination of information from the two farms to Irish dairy farmers through the Teagasc advisory network as part of the BETTER farm programme using open days, regular updates in the Irish Farmers' Journal, publications in farm newsletters and appropriate electronic media.

(2) New entrants to dairying

As part of the 'Health Check' agreement in November 2008, the Council of Ministers agreed to increase Member States milk quotas annually by 1% over the period 2009 to 2013. This was to ensure a 'soft landing' as milk quotas will expire by April 2015. The first of these increases came into effect on 1 April 2009. On 14 April 2009, the Minister for Agriculture announced the allocation of one-quarter (0.25%) of the 1% on a permanent basis to New Entrants to Dairying. In late September, the Minister announced the allocation of 200,000 litres of milk quota to each of 70 successful applicants. These applicants include new entrants and conversions from existing beef/sheep/cropping enterprises. It is very important that these new entrants to dairy production are successful as it will influence the level of expansion in milk production in future years. Successful applicants are required to attend training facilitated by Teagasc, which took place in December 2009 over a two-day period and will be followed by a one-day course every six months thereafter. Additionally, Teagasc is, at present, developing a research/development programme on how best this transition should be achieved.

(3) Greenfield dairy farm

Research and technology development models such as this have been used very successfully in other countries with similar underlying objectives e.g., the Lincoln University Dairy Farm in New Zealand. This award-winning development, through the application of scientific principles on a stand-alone commercial farm, has set new benchmarks for pasture-based dairy farming in New Zealand. As a focal point for technology transfer, the farm has attracted record numbers of farmers to field events. In an effort to replicate the LUDF model in an Irish context, Teagasc has set about developing a new project with the help of Glanbia, Agricultural Trust (Irish Farmers' Journal) and FBD Trust.

A suitable farm for a dairy conversion was identified in Co Kilkenny whereby the owners are willing to rent the farm for a period of no less than 15 years. A new limited company has been set-up incorporating the following three shareholders: Glanbia, Irish Farmers' Journal and the farm owners, as equal partners. The new company has leased 117 hectares from the farm owners. The farm was in continuous cereal production for a number of years and this autumn 85 hectares of the farm was reseeded, the remainder will be reseeded next spring. A low cost, labour efficient farm infrastructure has been developed. It is planned to establish a herd of approximately 250 cows by next spring increasing to c.300 cows over time. The approximate capital requirement to set-up and stock the farm will be less than €1.0 million of which 70% will be borrowed from AIB and the remaining 30% funded equally from the three shareholders. The company has recruited a full-time farm manager who will be responsible for the day-to-day management of the farm. The farm manager will report to the Project Manager nominated by Teagasc. Teagasc Moorepark will provide management services to the project which will include business planning and intensive technical support. In return for these services, the farm will be used extensively as a platform from which to establish a National farm extension and advisory programme for the benefit of Irish dairy farmers.

Similar to the first project on existing family dairy farms, Teagasc in association with the Irish Farmers' Journal, will manage the dissemination of information from this farm to the wider Irish dairy farming community through its advisory services as part of the BETTER farm programmes. It is hoped that the information emulating from this project will be of significant help to those suppliers who are planning a long-term future in profitable, low cost milk production. The profit generated from the operation of this business will be used for debt pay down, reimburse the three equity partners' investment and defray the additional expenses associated with the dissemination of information from the farm. The milk quota for the duration of this project has been licenced by Department of Agriculture, Fisheries and Food.

Adrian Van Bysterveldt joined Teagasc as a Dairy Development Technologist earlier this year. The offer of this position was as a result of his close involvement with the Lincoln University Dairy Farm Project in New Zealand. Adrian has played a key role in the design and layout of the farm infrastructure, and will be involved in the operation and labour management and the dissemination of information from this project.

Potential outcomes

Ireland has a comparative advantage in the production of dairy products based on a variety of EU cross country measures of competitive performance because of our temperate grass growing climate and lower costs of milk production. This competitive advantage can be further improved through improvements in productivity and scale at farm level. The information generated from this project will be of significant value to the Irish dairy industry in the years ahead.

Greenfield Dairy Farm – Projections

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Summary

- EU CAP reform will result in increased expansion opportunities for dairy farmers in Ireland.
- Expansion must be based on the development of a business plan which sets out realistic objectives, identifies a plan and develops strategies around risk.
- The business plans should be based on realistic targets in relation to herbage production and dairy cow performance including animal health issues in relation to the establishment of a new herd.
- Based on the assumption taken in this analysis a milk price of 23 to 24 c/l is required in order to make this project financially viable in the first five years.
- Financial projections suggest that at the end of the 15 years this project would have generated €853,218 surplus cash and a stock value of €523,500 for a total investment of €1.1 million (includes the equity of €350,000).
- Sensitivity analysis showed that the factor with the greatest impact on the financial outcome of this project is milk prices.

Introduction

The recently agreed CAP reform (the Health Check) will see an increase in Ireland's milk quota allocation of 1% per year between 2009 and 2014, which will be coupled with a corresponding reduction of the milk quota correction from 18 litres to 9 litres in every 1,000 litres for every 0.1% increase in milk fat concentration above the reference levels. EU member states have already agreed that the milk quota regime will not continue beyond 2014 and this latest reform represents a continuation of the EU policy to reduce the levels of market support within the EU and to allow the countries that are efficient at producing milk to expand their milk production. For the Irish dairy industry, this reform constitutes the first significant opportunity to expand milk production since 1984.

While current milk prices might not give rise to much enthusiasm for expansion, it is important for farmers to look beyond the current market gloom and plan for a viable future in milk production. The EU Commission has stated that they will review their milk quota policies in December 2010 and 2012 to ensure that milk quota value is being reduced in individual member states, paving the way for the eventual complete removal of milk quotas in 2015. The relaxation of milk quota policies will force Irish farmers to assess their own position in relation to future milk production. Irish farmers will have to decide, in the short-term, do they plan to expand their dairy business, remain static or exit milk production altogether; for those currently outside of dairying the possibility of becoming dairy farmers will become more real. Milk price volatility, as experienced in 2008/2009, will also force Irish farmers to reassess their costs of production in order to ensure that they will be capable of surviving extreme low milk price scenarios. The economics of milk production at farm level will dictate the extent to which national milk supply will increase when milk quotas are removed. The current production costs and the cost of expansion will be the main determinants of expansion with the milk price determining the speed of expansion in a profitable expansion plan. Recent surveys show that there is significant potential within existing structures for significant expansion on many farms (O' Donnell et al., 2008). However, one of the key concerns for an expanding dairy industry is the number of replacement animals available. On average, there are only enough replacement heifers (24%) available to maintain the herd at current levels with an average replacement rate nationally at, or above, 24% (O' Donnell et al., 2008). The most urgent action required at farm level is for dairy farmers to breed more dairy cows to high EBI (high fertility) dairy AI. These animals will have a significant value as the demand will be high for dairy heifers in an expanding dairy industry.

While it is accepted that the vast majority of expansion will come from the increased scale of existing structures there will also be an increased level of conversion from existing enterprises to dairying, similar to the Greenfield dairy project. The objective of this paper is to present the biological and financial projections for the 15 years of the investment under three headings.

(1) Business plan development
(2) Risk identification
(3) On-going monitoring

(1) Business Plan development

The development and application of a business plan is the first stepping stone in the development of a thriving and successful business. For any business to survive and prosper long-term it must constantly innovate to reduce costs and increase output. This model has been successful (e.g., Ryanair, Kerry Group, CRH, Dell etc). A dairy business is no different. In the business plan a review is required of resources and from this a plan for the future can be prepared. The business model that dairy farmers select for the future must be based around surviving price and weather shocks and be about setting up the business to capitalise when the price increases. This ultimately means producing milk at the lowest cost possible, while reducing the capital investment requirement through the use of low cost housing technologies. This is the model used in the Greenfield dairy farm. The business plan is designed to be as realistic as possible with sensitivity analysis carried out to determine the effect of variability in key input variables. The business plan is assessed under a number of headings:

a) General assumptions
b) Biological assumptions
c) Economic assumptions
d) Capital assumptions
e) Physical and financial projections
f) Sensitivity analysis

(a) General assumptions

This farm business is being set up to run for a 15-year period. The farm consists of 117 ha of which 114 ha is utilisable. The objective of the business is to maximise the return to the shareholders while farming in an environmentally and animal friendly manor, whilst at the same time maximising labour efficiency. Replacement animals will be reared off farm, leaving the farm at two weeks of age and returning in the month of December prior to when they are expected to calve. All male calves will be sold directly from the farm. The farm will be run with two full-time staff and some relief at particular periods, therefore achieving high levels of labour efficiency is a key objective of the business.

(b) Biological assumptions

Table 1 shows the biological assumptions for the farm over the 15 years of the investment. It is expected that there will be 250 cows calving down in Year 1 and that they will produce 4,984kg of milk at 3.40% protein and 3.90% fat while this is sustained on the farm by a total herbage production of 9.2t DM/ha. As the herd will be formed from the combination of a number of herds it is expected that there will be higher than normal animal health costs and reduced animal performance affecting total output. This will culminate in high replacement rates, mortality and veterinary costs initially. By year 15 it is projected that 350 cows will be calving down, producing 5,438kg of milk at 3.65% protein, 4.30% fat and 1,303kg MS/ha, sustained by a total herbage production of 16.2t DM/ha. The overall summary of the expected performance is poor initially, with significant animal health costs. Over the 15 year period it is projected that animal health costs will reduce and that the performance from the farm will increase substantially.

(c) Economic assumptions

Table 2 shows the economic assumptions included in the analysis. A milk price of 24cpl was assumed for this analysis even though it is expected that the milk price will be higher based on the latest FAPRI projections (Binfield et al., 2008). However as the dairy enterprise is vulnerable to price fluctuations and after the recently experienced milk price volatility it was decided to complete the farm financial projections using a conservative milk price of 24cpl. Sensitivity analysis was carried out to determine the effect of higher and lower milk prices. Land rental costs were assumed to be €450/ha, cull cow value of €350, male calf value of €75, with the contract replacement heifer rearing costs of €670. It was assumed that a low spec concentrate would be fed at a cost of €150/tonne. It was assumed that the interest rate would be 4.5% with the exception of Year 1 where the interest rate has been set at 2.84%. It was assumed that the costs in the business would be subjected to inflation and were increased by 2.5% per year from the base of 2010. Sensitivity analysis was carried out on the effect of variation in interest rates and the inflation rate over the 15 years.

(d) Capital investment

Table 3 describes the capital assumptions in this analysis. Due to current and expected future milk price volatility and to ensure liquidity at times of low milk price the capital investment was minimised while taking cognisance not to effect the labour requirement of the business. The total investment on the farm can be divided into three categories: (1) dairy stock, (2) grazing infrastructure, (3) housing and milking infrastructure. Within the investment categories the vast majority of the activity around minimising the investment has been centred in Category 3. This included low cost infrastructure which included a stand-off pad and earthen lined slurry storage tank. All investment in this category will not affect the productivity of the farm while investments in stock and the grazing infrastructure will have substantial effects on the farm productivity. Included in the assumptions is a contingency budget of 10% (approx €100,000) which will cover issues that may arise in the form of budget over runs and/or additional expenditure not budgeted for in the initial budgeting exercise. There was €350,000 included in the total investment of €1,099,650 in the form of share holders equity with the remaining requirements €749,650 borrowed over a 15-year period with a moratorium on capital repayments for the first three years.

(e) Physical and financial projections

Table 4 describes the projections for the farm over the 15 years of the investment. In 2010 there will be 250 cows milking, producing 1,245,976kg of milk, which is projected to increase to 350 cows producing 1,903,440kg of milk over the 15 years. The labour costs increase right throughout the period whilst the veterinary costs initially decline but then increase as effects of inflation and increased cows numbers outweigh the increased health status of the herd. The milk price that is received increases throughout the period as milk solids concentrations are projected to increase. The annual bank repayments from Years 4 to 15 are €87,211. All borrowings are fully repaid at the end of the 15-year period.

There is annual profit and surplus cash figure quoted in Table 4. While the profitability of the business is extremely important, in a venture like the one presented, the surplus cash generated from the business is even more important. This is because in a situation where a dairy farm is starting up and expanding there is a significant draw on cash. If the business cannot meet its cash requirements over this initial period it may become insolvent albeit may still be potentially profitable. It can be observed from the projections that over the years from Years 1 to 4 the business is vulnerable to external or internal shocks while after this period the farm performs well. All of the projections included in this analysis are designed to be conservative in the initial period due largely to the level of unknowns from the farm and to survive the first number of years where the business is at its weakest. At the end of the 15-year period while the fixed structures on the farm will have been depreciated to zero they will still have a functional value. If the farm was continued for an additional five years it would be capable of generating substantial amounts of cash as there would be no bank borrowings to be repaid which account for €87,211 annually. While the fixed structures have no value the stock will have a value at the end of the 15-year period. It is projected based on having 300 saleable cows @€1,300, 65 replacement heifers @€1,300 and 70 yearling heifers @€700 that stock values at the end of the period would be €523,500. When the value of the stock and the surplus cash are summed together the total surplus cash with all costs except tax paid would be €1,376,718 based on the projections for the farm.

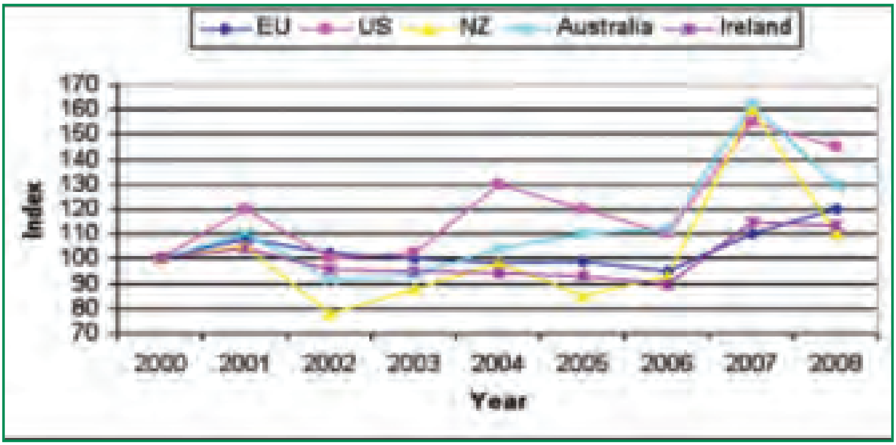
(f) Sensitivity analysis

Table 5 shows the effect of variation in milk price, interest rates, cost inflation and concentrate costs on surplus cash generated from the business over the 15 years of the investment. While the business still generates a positive cash return over the 15 years at a milk price of 22c/l in the initial period (Years 1 to 5) of the investment there is extreme pressure on the business. Therefore the business can cope with milk price shocks throughout its lifetime but is exposed at the initial phase. At a milk price of 26c/l the business generates very healthy cash flows right throughout the period of the investment. The base interest rate used for the analysis was 4.5% with the exception of Year 1. Reducing rates by 1% resulted in an additional €70,609 to be generated over the 15 while at the same time reducing the pressure on the system in Years 2 to 4, while increasing the rates had the opposite effect. The rate of costs inflation was taken at 2.5% which is below the measured agricultural rate increases nationally between 1998 and 2006 of 3.5%. Increasing or decreasing the inflation rate on costs has a substantial effect on the amount of surplus cash generated from the business. However, the effect is most severe at the later period when the business is at its strongest in terms of the cash that is being generated and therefore the business should be in a good position to deal with fluctuation around these key variables. Concentrate cost is included at a cost of €150/t. The feed budget is designed to maximise the amount of grass in the diet and to therefore minimise the quantity of purchased feed therefore variation in concentrate cost has a relatively small effect on the overall performance of the business.

(2) Risk identification

Uncertainty is a fact of life. It creates a business environment that provides both opportunities and threats (Shadbolt, 2009). Risk can be both positive or negative. The important question is how much is the business "at risk", or how vulnerable is the business to external pressures (weather, price, etc). It can be expected that milk price fluctuation will pose the greatest risk to the dairy business. However, there are other risks to the business. These include financial risks (feed, fertilizer, interest rates and fuel), weather risks and disease risks (BVD, IBR, Johnes, etc). There may be other risks that are relevant depending on circumstance and locations. The business plan should set about developing strategies that will test the effect of each of the identified threats. Figure 1 shows the volatility in price for a selected number of countries over the past ten years. It is clear that the volatility in price has become much more pronounced in recent years. This is the case not only in the EU, but also in New Zealand and Australia, where milk price increased by 60% from 2006 to 2007 and then slipped back again. Price fluctuation will force dairy farmers to focus on lowering costs. It is no accident that the lowest costs were observed in the regions where price fluctuation was largest. Risk reduction strategies may be implemented, depending on the aversion to risk of the producer. For example one source of insulation that has helped some producers in 2009 is being in a position where they have a large proportion of heifers reared that could be used for expansion but in a scenario where cash flow is a problem they can also be sold.

Figure 1. Milk price between 2000 and 2008 in the EU average, US, NZ, Australia and Ireland



(3) Ongoing monitoring

While drawing up the plan, identifying the risks and implementing the plan are vital steps in the development of a successful business so too is the requirement to develop a protocol to develop budgets for the farm and to set protocols for the continual monitoring of the business. It is only through the strict application of detailed budgets that the business can strive to achieve its targets. An implementation plan on how the key technologies (grassland management, genetics, etc) will be advanced on the farm developed. A set of key performance targets or indicators (KPI) should be identified. A strategy of how each of the individual components of the plan will be delivered and monitored should be identified.

There is a requirement to implement a measurement protocol for each of the KPI in order to benchmark performance within and between years and also benchmark against the plan for the business. These protocols will be essential if the plan is to be implemented successfully and include grass budgeting, financial budgeting and herd recording. Each year the farm should be benchmarked against the plan, against other farmers in the locality or discussion group, against the top farmers and finally against what is being achieved at research level. There may be a need to adjust the plan periodically but the overall mission statement should be kept central to the plan of the business.

Conclusions

For many dairy farmers the forthcoming reforms to the EU milk quota regime will represent the first real opportunity to expand milk production. Analysis shows that significant capacity and potential exists at farm-level to expand production even on existing land holdings. However, current milk price volatility is such that the cash requirements and future liquidity of the business must be key components in the expansion plan. Better utilisation of grass and investment in low cost housing are the foundations of viable expansion. There is an urgent requirement for all dairy farmers to develop business plans which will include both long-term and short-term objectives and requirements. The technology is available to create the opportunities that will underpin any expansion at farm level. Insulation from a large proportion of the volatility can be achieved by focusing the dairy farm business around low cost grass based technologies.

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Table 1. Biological performance assumptions included in the economic analysis

Year	Protein %	Fat %	Milk yield kg	Cows in milk	MS/Ha	*Replacement Rate %	Additional Veterinary cost €/cow	Total vaccines €/cow	Mortality in calves %	Mortality in cows %	Herbage production kgDm/Ha
1	3.41	3.90	4,984	250	761	27	20	50	7.0	6.0	9,205
2	3.41	3.90	5,125	270	846	25	15	45	6.5	5.0	10,386
3	3.42	3.93	5,231	290	933	23	10	40	6.0	4.5	11,667
4	3.46	3.99	5,340	300	999	22	0	30	5.5	4.0	12,462
5	3.48	4.03	5,386	310	1,049	20	0	30	5.0	3.5	13,216
6	3.49	4.07	5,434	320	1,101	18	0	25	5.0	3.0	14,059
7	3.52	4.11	5,442	330	1,146	18	0	20	5.0	2.5	14,714
8	3.54	4.15	5,438	340	1,191	18	0	20	5.0	2.5	15,349
9	3.57	4.18	5,438	350	1,235	18	0	20	5.0	2.5	15,997
10	3.61	4.22	5,438	350	1,283	18	0	20	5.0	2.5	16,091
11	3.63	4.26	5,438	350	1,294	18	0	20	5.0	2.5	16,170
12	3.65	4.30	5,438	350	1,303	18	0	20	5.0	2.5	16,244
13	3.65	4.30	5,438	350	1,303	18	0	20	5.0	2.5	16,244
14	3.65	4.30	5,438	350	1,303	18	0	20	5.0	2.5	16,244
15	3.65	4.30	5,438	350	1,303	18	0	20	5.0	2.5	16,244

**Replacement rate required to maintain the herd. Additional animals required for expansion*

Table 2. Economic assumptions included in the analysis

	Default
Farm size (ha)	117
Farm size net (ha)	114
Gross milk price 2010-2025 (c/l)	24.0
Land rental costs (€/ha)	450
Cull cow value (€)	350
Male calf value (€)	75
Replacement heifer rearing cost (€)	670
Concentrate costs (€/t)	150
Urea (€/t)	320
CAN (€/t)	250
1st cut silage (€/ha)	250
2nd cut silage (€/ha)	190
Interest rate (% pa)	4.5*
*Cost inflation (% pa)	2.5

** Inflation on costs included on fertilizer, machinery hire, silage making, vet, AI and medicine, farm consultancy, electricity, labour, machinery operation and repair. Inflation rate taken at 2.5%pa from base of 2009 (not compounded)*
**Initial interest rate 2.834%*

Table 3. Investment assumptions included in the analysis on the modelled farm

Item	Description	Cost
Stock	265 lactating cows €1,300 85 heifers @ €1,300	€344,500 €110,500 (End Year 1)
Grazing Infrastructure		
Reseeding of farm	117 ha, one pass till, sow, roll + grass seed + fertilize	€35,000
Fencing	20,000 m @ €0.9/m	€18,000
Water supply	40 water troughs + 7 km water pipe laid + water store	€22,400
Water storage tank	24,000 L tank	€4,100
Boring of well		€3,000
Farm roadways	3 Km of 5 m wide roadways @ €15/m Move existing roadways	€52,000
Farmyard Infrastructure		
Milking parlour	30 unit herring bone shed + dairy + collecting yard and office	€130,500
Milking plant	Milking plant	€29,600
Milk tank	22,500L outdoor milk tank	€25,640
Wiring milking parlour		€8,000
Plumbing milking parlour		€6,000
Slurry store	3500 m^3 earth lined slurry lagoon	€35,000
Head feed	87 m length	€10,100
Wintering pad	3600m^2 woodchip pad @9/m2	€32,400
Calf housing		€23,500
Silage slab	Silage bases	€16,300
Electricity supply	3-phase transformer + connection fee	€9,742
Digging + stone for parlour, calf housing and silage slabs		€10,000
Miscellaneous		
Machinery	Jeep and tractor	€20,500
Labour	Labour from Start to December	€3,500
Planning	Drawings + site assessment + mapping + planning application + council development fee	€20,000
Construction of new entrance	Digging + stone + new wall+ bitumen + marking	€10,000
Working capital	Feed	€14,400
Office	Computer, farm package, phone connection, broadband etc	€5,000
Contingency	10% allowance to allow for unexpected costs that may arise	€99,968
Total		**€1,099,650**
Borrowed		**€749,650**
Equity		**€350,000**

Table 4. Farm projections over the 15 years of the investment

Year	Cow	Milk produced kg	*Labour costs €	Milk prices c/l	Interest repayment €	Capital repayment €	Veterinary cost €	Profitability €	Surplus cash €	Borrowings year-end €
0	0	0	3,500	0	0		0	0	0	
1	250	1,245,976	88,800	26.2	24,175	0	34,453	-7,066	24,093	749,650
2	270	1,383,619	91,020	26.2	38,734	0	35,368	-26,756	4,403	749,650
3	290	1,517,064	93,240	26.4	38,734	0	38,863	-1,057	30,101	749,650
4	300	1,602,113	95,460	26.9	38,734	48,477	31,533	35,034	17,715	701,173
5	310	1,669,677	97,680	27.1	36,553	50,658	33,339	49,656	30,156	650,515
6	320	1,738,864	99,900	27.3	34,273	52,938	33,394	70,156	48,376	597,576
7	330	1,795,874	102,120	27.5	31,891	55,320	33,303	84,633	60,471	542,256
8	340	1,849,056	104,340	27.9	29,402	57,810	35,055	96,628	69,977	484,446
9	350	1,903,440	106,560	28.1	26,800	60,411	36,851	108,717	79,465	424,035
10	350	1,903,440	108,780	28.5	24,082	63,130	37,619	122,293	90,321	360,906
11	350	1,903,440	111,000	28.7	21,241	65,971	38,387	123,836	89,024	294,935
12	350	1,903,440	113,220	29.0	18,272	68,939	39,155	125,342	87,561	225,996
13	350	1,903,440	115,440	29.0	15,170	72,041	39,922	122,598	81,715	153,954
14	350	1,903,440	117,660	29.0	11,928	75,283	40,690	119,994	75,869	78,671
15	350	1,903,440	119,880	29.0	8,540	78,671	41,458	111,484	63,971	0
Total									853,218	
Stock Value at end of period										
Cows 300*€1,300									390,000	
Replacement heifers 65*€1,300									84,500	
Yearlings 70*€700									49,000	
Cash Surplus + Stock value									1,376,718	

All machinery operations are being contracted including fertilizer spreading. There will be a similar profit share relationship negotiated between the farm owners and the equity partners. Fixed facilities are depreciated fully over the 15 years of the investment.

Table 5. Sensitivity analysis around key input parameters on surplus cash with a base of 24c/l

	Base	Base milk price 24c/l		Interest rate 4.5%		Cost inflation 2.5%		Concentrate cost	
Year		**-2c/l**	**+2c/l**	**-1%**	**+1%**	**-1%**	**+1%**	**£120**	**£180**
0									
1	24,093	-2,062	50,252	24,093	24,093	24,093	24,093	26,032	22,154
2	4,403	-24,662	33,471	11,899	-3,094	6,536	2,270	6,503	2,303
3	30,101	-1,945	62,151	37,598	22,605	34,517	25,685	32,366	27,836
4	17,715	-16,583	52,018	22,349	12,945	24,298	11,132	20,301	15,129
5	30,156	-5,846	66,163	34,791	25,386	39,173	21,139	32,962	27,351
6	48,376	10,645	86,112	53,011	43,606	59,740	37,012	51,285	45,468
7	60,471	21,219	99,728	65,106	55,701	74,176	46,766	63,603	57,339
8	69,977	29,203	110,756	74,612	65,207	86,151	53,808	73,337	66,617
9	79,465	37,176	121,759	84,099	74,695	98,163	60,767	83,062	75,867
10	90,321	47,581	133,068	94,956	85,551	111,361	69,282	93,919	86,724
11	89,024	45,976	130,912	93,658	84,254	112,405	65,642	92,621	85,426
12	87,561	44,217	132,077	92,196	82,791	113,286	61,837	91,159	43,964
13	81,715	38,371	125,065	86,350	76,945	109,778	53,562	85,312	78,118
14	75,869	32,524	119,219	80,503	71,099	106,270	45,467	79,466	72,271
15	63,971	20,627	107,322	68,606	59,201	97,339	30,604	67,569	60,374
Total	**853,218**	**276,441**	**1,430,072**	**923,825**	**780,984**	**1,097,286**	**609,150**	**899,495**	**806,941**
Stock value at end of period									
Cows 300*€1,300	390,000	390,000	390,000	390,000	390,000	390,000	390,000	390,000	390,000
Replacement heifers 65*€1,300	84,500	84,500	84,500	84,500	84,500	84,500	84,500	84,500	84,500
Yearlings 70*€700	49,000	49,000	49,000	49,000	49,000	49,000	49,000	49,000	49,000
Total	**1,363,718**	**799,941**	**1,953,572**	**1,447,325**	**1,304,484**	**1,620,786**	**1,132,650**	**1,422,995**	**1,330,441**

Growing Your Herd Using Best Breeding Practice

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Summary

- A lack of quality replacements is restricting the potential for expansion in the post-quota era. Current fertility levels in the Irish dairy herd continue to be substantially below optimum and are negatively impacting upon heifer supply and more immediately dairy farm profits. Irish dairy farmers must take immediate action by only using the "best genetics" available for grass-based systems and putting in place a strategy of best management practice.
- Maiden heifers are a key component of the dairy enterprise and must be managed accordingly to achieve optimum performance. Synchronisation programmes can help achieve early compact heifer calving as well as facilitating an improved supply of high quality replacements.

Fertility performance nationally limiting expansion

The dairy industry in Ireland is facing new and challenging times with the impending removal of the milk quota regime. Robust cows that will efficiently deliver high yields of milk solids from grazed grass, while continuing to go back in calf, consistently year-on-year, are invariably the goal. Such cows will maximise profit regardless of future milk price swings. Currently, however, fertility performance (conception rates, survival and calving pattern), continues to be sub-optimal, eroding profit margins on Irish dairy farms and restricting the supply of high quality replacements. Data from the ICBF (Cromie, personal communication) indicates that even in the top 10% of spring-calving herds based on EBI, replacement rate (incl. recycled cows) is in excess of 30% annually with a mean calving interval of 380 days. This level of performance is costing these farmers in excess of €12,500 per year, at the scale of a 100-cow herd, compared to a target replacement rate of 18% and a calving interval of 365 days. The cost of poor fertility is even greater in lower EBI herds.

The potential to expand post-quota necessitates an increasing supply of quality replacements. For some, expansion will be the aspiration, for others there is the opportunity to benefit from improved herd performance or capitalise on the increasing demand for replacements from those choosing to expand. This necessitates the number of replacement heifers to be greater than the number of dairy cows that are removed from the herd due to culling and death. In Ireland, while progress has been made in recent years we are struggling to achieve this objective. The Irish CMMS data reveals that the proportion of dairy bred females born to the dairy herd has risen somewhat in the last three years from 21 per 100 cows to 26 per 100 cows. On the face of it this may appear acceptable. The reality is that when issues such as 1) the pattern of births nationally (only 68.6% of these are born during the months of January to March), and 2) the expected losses from birth to lactation (over 10%) are considered, it is clear this level of supply is not sufficient to sustain the current national herd, let alone facilitate expansion. Irish dairy farmers are minimising the cost of current performance by recycling cows; estimated at 18% nationally in spring-calving herds (10% in the top 10% of spring-calving herds based on EBI). Also, of the 268,000 dairy heifers born in 2009 it is estimated that only 55.6% were sired by an AI bull. This is up from 45.5% in 2006 indicating an increase in AI usage in recent years. So, there are clear issues with regard to the quantity and quality of replacement heifers available to service the national herd going forward. The trend is in the right direction but pace of change needs to be accelerated.

Use high EBI

Genetic improvement for Irish dairy farmers, should constitute increases in herd productivity through genetic improvement in solids output potential, and reduced costs by genetically improving reproductive efficiency/survival as well as animal health (udder health, lameness etc). Improvements to calving interval and survival (fertility sub-index) will also improve productivity via potentially longer lactation lengths as well as increasing the proportion of cows reaching maturity and the consequential increased production capacity that ensues. It must be appreciated that genetic change, be it improvement or otherwise, is cumulative and permanent.

The EBI has been developed to enable Irish dairy farmers identify sires most likely to provide the most profitable dairy cows. The availability of sub-indexes within the EBI allows farmers to "fine-tune" the selection of bulls to address particular issues in their herd. The advent of genomic selection is a further advancement where the breeding value of young bulls can be predicted much earlier in life with greater accuracy. Similarly, genomic selection, together with improved bull dam identification procedures, mean a greater selection of very high EBI bulls (substantially superior than those available to date) are available for use by Irish farmers. One consideration, however, is that the reliability of the breeding values of genomically selected bulls, is considerably lower (approximately 50%) than the maximum of 99% achievable in proven bulls. Nonetheless, the genetic merit (EBI) of the best genomically selected bulls will on average be superior to the genetic merit of most proven bulls available. The lower reliability of genomically selected bulls must be overcome by using teams of these bulls; a recommendation is to use at least five genomically selected bulls in a team. **Use of less than five genomically selected bulls in a herd is not recommended and should never be undertaken.**

There is an abundance of data to illustrate the superiority of high EBI. At Moorepark, two years ago a study was established to investigate the performance of cows of similar production potential but with contrasting genetic merit for fertility/survival (as indicated by their fertility sub-index). With the aid of the ICBF, the national database was screened for in-calf Holstein-Friesian heifers (animals with Kiwi Friesian genetics were excluded from selection) with similar genetic merit for production traits, but extremes of high or low genetic merit for fertility traits (as indicated by their production and fertility sub-indexes, respectively). To overcome issues regarding the low reliability of fertility proofs for individual cows, background pedigree information was used (sire and dams sire etc) in order to reflect a level of consistency with regard to genetic background for high/low genetic merit for fertility.

A total of 36 heifers due to calve in spring 2008 were purchased and moved to the Moorepark farm. All 36 cows had a similar percentage of Holstein-Friesian genetics (93%) and similar values for the milk production sub-index (€40). The 18 high fertility sub-index heifers had a fertility sub-index of €51 and an overall EBI of €105 and the remaining 18 had a fertility sub-index of €-30 and an overall EBI of €6. Cows with high fertility sub-indexes were sired by RUU, LBO, LLO and OJI while the low fertility sub-index group included the sires BIJ, VET, SYG and GUF. All 36 cows are managed as one herd in accordance with the Moorepark blueprint for pasture-based milk production. The production and fertility performance of each group during Year 1 of the study (2008) is summarised in Table 1.

Table 1. Milk production and reproductive performance during the first lactation for high and low fertility groups

	High Fertility sub-index	Low Fertility sub-index	Fertility targets
Milk Production (kg)	5069	5098	—
Milk solids (kg)	360	363	—
Average BCS	2.81	2.65	—
21-day submission rate (%)	83	72	90
First service pregnancy rate (%)	56	28	55-60
Six-week in-calf rate (%)	72	41	>75
Empty rate (%)	11	28	<10
2008 mean calving date	15 February 2008	09 February 2008	—
2009 mean calving date	17 February 2009	11 March 2009	—

There was no difference in milk production during their first lactation. Both groups yielded around 360kg milk solids per cow. The high fertility group maintained a better body condition score throughout lactation. This is particularly interesting, as all cows were fed and managed in a similar manner, suggesting a difference in energy balance existed between the two groups. In terms of reproductive efficiency, the high fertility group performed very well during the breeding season, having a higher submission rate, superior conception rates, less pregnancy loss (embryo mortality) and a lower overall empty rate than the low fertility group. The mean calving date for the high fertility group in 2009 was a massive 28 days earlier than the low fertility group, this means a more compact calving pattern, longer lactations, and a more profitable cow compared to the lower fertility group. The findings illustrate that breeding based on EBI will, with time, result in substantial improvements to animal performance and consequent profit.

Crossbreeding

There is also evidence from a diverse range of environments around the world that crossbreeding can provide an alternative means of counteracting the negative consequences (reduced reproductive efficiency/survival) of past selection programs due to heterosis or a combination of heterosis and breed difference. Although, as a mating strategy for dairy cows, crossbreeding is not novel concept, with the exception of New Zealand, crossbreeding has not been popular. This is most likely due to the historical divergence in yield potential between the available alternative breeds and the Holstein. However, acceptable levels of genetic improvement for milk production within these breeds, together with a requirement to improve reproductive efficiency at farm level, mean that interest in crossbreeding has been rejuvenated in many countries, including Ireland.

Since 1996, studies have been run at Moorepark evaluating the merits of a number of alternative breeds for crossbreeding under Irish conditions. The breeds of particular interest currently are the Jersey and Norwegian Red. The Jersey trial is based at Ballydague research farm (since 2006) and the primary aim is to evaluate the merit of Jersey×Holstein-Friesian cows under Irish conditions. Evidence from New Zealand suggests that Jersey crossbred cows are well suited to seasonal grass-based dairy production. The study at Ballydague is relatively small scale but with each passing year more data is generated, providing a clearer insight into what crossbreeding with Jersey could offer Irish dairy farmers.

The Norwegian Red is a breed that has been selected with an index not dissimilar in approach to the Irish EBI since the 1960s. Interest in the breed emanated from its long history of selection for female fertility and udder health alongside milk yield. A preliminary study carried out at Ballydague (2001-2005) demonstrated these positive attributes and was followed up with a larger on-farm study (2006-2008) run across 46 commercial dairy herds i.e., a study with large numbers, to 1) more conclusively evaluate the merits or otherwise of crossbreeding with Norwegian Red, and 2) provide suitable data that could be used by the ICBF to enhance breeding value estimations for crossbred cows.

Moorepark research findings indicate a very favourable response to crossbreeding. All studies show that productivity is at least maintained and importantly reproductive efficiency/survival is markedly improved. Fertility performance on all of the Moorepark studies was in line with fertility targets. Thus, facilitating profit maximisation and optional herd expansion. Preliminary economic analyses representing a 40 ha unit (or approximately a 100-cow enterprise) indicates profitability may be increased by up to €180 per cow with crossbreds compared to Holstein-Friesian cows. It should be stressed, however, that high genetic merit NR and J sires were used across the Moorepark studies.

Increasing the use of dairy AI

As highlighted, although increasing, the use of AI on Irish dairy farms remains low. The first step to remedy the situation is to increase the proportion of the herd that becomes pregnant to high genetic merit dairy AI sires. With good submission rates (~90%) and reasonable conception rates (~50%), six weeks of AI use at the start of the breeding season would result in 70% of the milking herd becoming pregnant to high genetic merit bulls. Maiden heifers should also be bred to high genetic merit (easy-calving) AI bulls. This ensures adequate replacements (up to 40 replacements per 100 cows having accounted for losses post birth) for cows culled from the herd (20 to 25%), and surplus heifers can be maintained in the herd for expansion, or sold as high genetic merit replacements in a buoyant heifer market. The recommendation is to use the minimum number of dairy AI straws that will provide you with your targeted number of heifer replacements in 2013 (Table 2).

Table 2. No of semen straws required to produce a replacement heifer as affected by herd conception rate and the number of straws required to provide 20 lactating heifers

Herd conception rate	No. straws required per heifer obtained	No. straws required for 20 replacement heifers*
40%	6.22	140
50%	4.98	110
60%	4.15	96
70%	3.55	80

** Includes an added 10% to allow for the vagaries in the proportion of heifer calves born, which is particularly important in small herds*

Maiden heifers

Well bred maiden heifers have the potential to substantially impact upon herd profitability in that 1) they should represent some of the highest genetic material in the herd in terms of potential profit, 2) if calved early they have a capacity to significantly improve herd calving pattern, and 3) if mated to high EBI sires will provide a (further) source of early-born high genetic merit replacement heifers for the future. Those who are wise will aim to maximise their efforts to ensure as many maiden heifers as possible will be bred early this season, and bred to an easy calving high EBI dairy sire.

To capitalise on these benefits the following approach is recommended:

- Heifers must be managed to ensure that they are cycling (have reached puberty) before the start of the breeding season.
- Synchronise heifers to concentrate heats with a prostaglandin regime (resulting in compact calving) and minimise heat detection efforts.
- Mate heifers with an easy-calving high EBI AI sire.
- If feasible, mate repeats with an easy-calving high EBI AI sire. Alternatively, 'mop up' repeats with an easy-calving high EBI dairy stock sire.

If these guidelines are put into practice, it is envisaged that approximately 70% of heifers would calve in the first three weeks of calving and 95% in the first six weeks. **Thus, it is possible to achieve 90% of cows calving in six weeks (with a fertile herd achieving a six-week in-calf rate of over 70%) and early calving heifers.**

Achieving target body weights is an integral part of heifer rearing systems. Previous research has indicated that heifers should be mated at 55 to 60% of mature liveweight and should calve at 85% to 90% of mature liveweight. Recommended mature liveweights vary considerably between countries. For example, in the US mature liveweight for Holstein cows is deemed to be 650kg. In New Zealand, however, this is 100 kg less. In practice on many Irish dairy farms heifer rearing receives low priority and achieving target weights is not an issue of concern to farmers. As a result potential milk production is unlikely to be realised. Reduced levels of management will result in a lesser profit, as heifers may calve later than 24 months and produce less milk compared to better managed heifers.

As part of the large on-farm Norwegian Red crossbreeding study run by Moorepark, almost 1,400 dairy heifers were intensively monitored from three months of age across 50 commercial dairy farms. This data set was used to establish guidelines in heifer rearing management.

Heifers were scanned, weighed and body condition scored prior to breeding. At the start of the breeding season the average weight and body condition score (BCS) was 326 kg and 3.28, respectively for the heifers that had reached puberty while it was 290 kg and 3.10 BCS for the non-cycling heifers. Averaged across all herds the proportion cycling was 79% ranging from 31% in the poorest herd to 100% in the best herd. The data also showed that it was possible to have heifers at the desired bodyweight and BCS at less than 13-months of age at MSD (mating start date) and to calve at 22 months of age. The following key points can be taken from Table 3.

- **Bodyweight and BCS** of maiden heifers at MSD is more critical than age
- Heavier heifers at MSD produce significantly more milk in their first lactation

- Heifers in low BCS at MSD calved later and produced significantly less milk during first lactation
- Weight at first calving also significantly affects second lactation milk yield

Table 3. Association between maiden heifer age, liveweight and body condition score at the mating start date (MSD) and cow production performance in first lactation

	Mean calving date	Predicted 305 day Yield	Predicted 305 day Fat%	Predicted 305 day Protein %	Milk produced	Pre-calving Weight
Age at AI (months)						
<14	Feb 23	5322	3.96	3.47	4648	
14 to 14.5	Feb 22	5294	3.99	3.47	4587	
>14.5	Feb 23	5223	4.04	3.47	4439	
Weight at AI						
≤290kg	Feb 25	5003	4.02	3.46	4186	482
291 to 316 kg	Feb 23	5235	3.99	3.46	4428	517
317 to 341 kg	Feb 21	5340	4.03	3.48	4722	541
≥342 kg	Feb 21	5540	3.96	3.49	4897	574
BCS at AI						
≤2.75	Mar 4	4963	4.09	3.49	4053	
3.00	Feb 21	5283	3.94	3.45	4615	
3.25	Feb 20	5387	4.01	3.48	4791	
≥3.50	Feb 21	5485	3.95	3.46	4773	

In order to ensure production potential is maximised the target bodyweights outlined in Table 4 must be achieved at MSD. These target weights are equivalent to 60% of target pre-calving first lactation weights. In addition maiden heifers should have a minimum BCS of 3.25 to ensure at least 90% are cycling at MSD. It is imperative that only easy calving sires are used on heifers i.e., sires with direct calving difficulty PTA values of 1.7 or less (consult figures provided by ICBF). To capitalise on higher weight gains aim to have heifers at grass at least one month prior to MSD.

Table 4. Bodyweight targets for maiden heifers at breeding and for heifers pre-calving by breed/crossbreed

	HF	NZ	HF*NZ	NR	HF*NR	J	HF*J
Maiden heifer LW(kg)	330	315	330	315	330	240	295
Pre-calving LW (kg)	550	525	550	525	550	405	490

HF = Holstein-Friesian, NZ = New Zealand HF, NR = Norwegian Red, J = Jersey

Heifer synchronisation

Synchronisation should be utilised as a management tool to maximise the number of heifers that become pregnant as quickly as possible after MSD. The most popular and cost-effective synchronisation protocols for heifers involve intramuscular injections of prostaglandin (e.g., Estrumate, Lutalyse, Enzoprost etc). Prostaglandin synchronisation protocols work very well for heifers that have started cycling, but will not work in non-cycling heifers. The following protocol is recommended:

- Tail paint all heifers, and inseminate following observation of oestrus during the first six days of the breeding season.
- All heifers not inseminated in the first six days receive a prostaglandin injection on day seven, and are inseminated following observation of oestrus in the next three to five days.
- Heifers that failed to come into heat following the first injection of prostaglandin receive a second injection 10 days later.
- Heifers are again inseminated at a standing heat, or receive fixed time AI at 72 and 96 h after the second injection.

This protocol generally results in submission rates close to 100% (assuming all heiers are cycling regularly prior to administering the protocol) and conception rates to first service of 70%. If possible, all heifers should be observed for repeat heats and inseminated to a high EBI easy-calving AI bull, and a stock bull introduced to "mop up" five to six weeks after the start of the breeding season. If it is desired to reduce costs and use less prostaglandin, the first injection of prostaglandin can be delayed until day 10, and the second injection would then be given on day 20. Another alternative, if it is not possible to dedicate time to daily heat detection (e.g., heifers on an outside block), all heifers could be injected with prostaglandin 12 days before MSD and again two days before MSD. With this protocol, most heifers will be in heat in the first three days of the breeding season, and those not seen in heat could receive fixed time AI at 72 and 96h after the second injection. However, the cost will obviously be much higher due to the greater amount of prostaglandin required (two injections for all heifers).

Conclusion

Irish dairy farmers must take immediate action to increase the number of replacement heifers being generated nationally. This requires a strategy to improve reproductive efficiency which currently is substantially below optimum. Two important steps include 1) increased use of AI using the highest available EBI dairy sires, 2) management of maiden heifers to improve calving pattern and simultaneously increase the future supply of replacement heifers. The target should be 45 dairy bred high EBI (straight bred or crossbred) heifer calves per 100 cows calved - all born in the first six weeks of the calving season!

Biosecurity Blueprint for Purchasing Cattle

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Summary

- The three steps to reduce disease risk are 1) don't buy disease 2) know your herd health status, and 3) review animal medicines usage annually.
- The focus of this article is on what you can do to reduce your risks of buying-in disease using the Greenfield Dairy Farm as an example.
- All breeding animals should be tested for regulatory and non-regulatory diseases before mixing with a new herd.
- Discuss the details of these herd health measures with your local vet.

Infectious diseases on Irish dairy farms

Non-statutory infectious disease agents currently affecting Irish dairy herds include BVD, IBR, Johne's, leptospirosis, salmonellosis, neosporosis and mycoplasmosis. In addition to these individual agents, multiple infections causing pneumonia (e.g., pasteurella, PI3, RSV) and diarrhoea (rota and corona viruses, cryptosporidia) continue to be the most important infectious diseases resulting in illthrift and mortality in calves and weanlings on Irish dairy farms. A recent Teagasc Moorepark bulk milk survey of 250 farms nationally showed that antibodies to certain infectious diseases are widespread in our dairy herds.

- Leptospirosis, BVD and IBR (over 80% of herds antibody-positive)
- Salmonellosis (65%)

For some herds this is due to vaccination while in others where vaccination rates are low, for example, IBR, this survey shows widespread exposure.

Why is this?

The introduction and current widespread distribution of Johne's and Mycoplasmosis can almost be directly attributed to the increase in importation of livestock into Ireland in the early 1990s. The considerable amount of animal movement between farms in Ireland is also a significant contributor to the increase in prevalence of these diseases. The Teagasc survey of Irish dairy farmers in 2008 found that over 50% of Irish dairy herds can be classed as open herds (i.e., free movement of cattle onto the farm), while only 25% of herds classified themselves as closed herds (i.e. no movement of cattle onto the farm). Hence,

- our cattle movement patterns
- herd expansions
- fragmented holdings, and
- lack of non-regulatory pre-movement testing

has resulted in widespread exposure to infectious diseases on many dairy farms today.

What can you do to control animal disease in your herd?

Outlined hereunder are the key steps in the control of infectious diseases on dairy farms. The focus of this article is on what you can do to reduce your risks of buying-in disease using the Greenfield Dairy Farm as an example.

Step 1: Don't buy in disease

A recent Teagasc survey has shown that nine out of ten dairy farmers carry out no additional routine herd health screening when buying-in. Key biosecurity measures to allow risk-informed trading and to prevent the introduction and spread of infectious diseases are:

- A closed herd policy (i.e., no cattle movement, including bulls, onto the farm) will block the direct importation of disease onto a farm.
- If you have to buy-in breeding stock (and their offspring, as appropriate) test for both regulatory and non-regulatory diseases.
- On-farm biosecurity measures, such as stock and disease-proof boundaries (three meter gap between neighbouring farms to prevent nose-to-nose contact), footbaths, restriction of visitors, disinfected veterinary equipment and single-use disposable needles will increase protection against the introduction of infectious diseases onto a farm.

Remember when you buy-in a pregnant animal you are buying two animals, only one of which you can test pre-movement, the dam. These measures should be standard on all dairy farms.

In the case of the Greenfield Dairy Farm the following procedures are planned to reduce the risk of buying in disease problems.

Selection of stock for purchase

In descending order of priority, the following criteria will be used to select pregnant heifers for purchase:

1. *Health status of the herd of origin and of the stock for purchase*

- Brucellosis, TB and Johne's disease unrestricted history in the vendor's herd and test-negative stock for purchase.
- BVDv and Neospora caninum-negative stock for purchase.
- No Mycoplasma bovis positive stock for purchase.
- Vaccination and biosecurity history of the vendor's herd and the stock for purchase.
- Clinically healthy, pregnant, good condition, stock for purchase.
- No multiple teats or teat placement that would result in milking and disease issues in stock for purchase.

This information will be obtained through vendor and private veterinary practitioner (PVP) declaration, local District Veterinary Office (DVO) records and by inspecting and sampling/testing the stock for purchase before deciding to buy (see details below).

2. *Cost*
- Animal plus disease sampling and testing and transport to fit within budget.

3. *Bodyweight*
- Within recommended guidelines.

4. *Genetics*
- AI-bred and be in-calf to an AI sire as much as possible.
- As high an EBI as possible within financial budget constraints; with emphasis on fertility subindex.
- Crossbreed dairy stock will be considered.

Processing of stock after purchase
- Once sale is agreed, the stock for purchase should be isolated on the vendor's farm.
- Quarantine upon arrival for a minimum of 30 days and ideally keep each group separate until after calving.
- Re-test for brucellosis within 60 days post-movement.
- Vaccinate against BVD, leptospirosis, IBR and salmonellosis at least a week after arrival.
- Medicate against fluke, worms, lice and mortellaro.
- Investigate all abortions - daily inspection of all pregnant animals and immediate individual isolation of any animal that is suspected of abortion, or has aborted with subsequent sampling. Aborted fetuses/placentae and calves which die within two days of calving will be examined postmortem at Teagasc Moorepark.

Step 2: Establish and monitor your own herd's health status
There are now new tests which allow economical screening of herds using:
- bulk milk testing
- targeted blood sampling of weanlings
- pooling of samples to reduce costs
- ear-tag testing of calves.

These test methods can be used annually to provide an on-going insight into the disease status of a dairy herd and provide valuable supporting information for the implementation of both biosecurity and vaccination protocols. In the case of purchased pregnant animals, for example on the Greenfield Dairy Farm, it is planned to sample and test their replacement offspring for BVDv (by ear-tagging of calves) and Neospora caninum.

Step 3: Review your animal medicines usage
A recent Teagasc survey has shown that vaccines are used on nine out of 10 dairy farms to control animal diseases. Vaccination programmes are best implemented where there is close veterinary involvement in the whether, which and when details of the programme.

- Whether to use a vaccine or not?
- Which vaccine to use?
- When to administer the doses?

Vaccines should be viewed as a component of a control programme but not the sole means of disease prevention within a herd. Over-reliance on vaccination without the backup of proper management, biosecurity and diagnostics should be avoided. Vaccine breakdown is a potential consequence. In the case of the Greenfield Dairy Farm, vaccination programmes for BVD, leptospirosis, IBR and salmonellosis are planned. In addition, animals will be routinely treated annually for worms, fluke and lice, as appropriate. All high somatic cell count and mastitic animals are to be kept in a separate herd which is milked last. All mastitis cases will be tested for bacterial cause and all animals treated with long acting dry cow intramammary tubes at the end of lactation.

In reviewing your own herd's health consult with your local vet on how best to implement a herd health programme using these three simple steps to protect your herd.

Animal Health Ireland (AHI)

AHI is planning to convene a technical working group (TWG) in February 2010 to deal with the issues surrounding the biosecure purchase of breeding animals on Irish farms. This TWG will produce technical guidelines on best-practice risk-informed trading for stakeholders nationally.

Milking Large Herds – What is the Optimal Parlour Size?

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Summary

- The optimum number of clusters in a parlour will depend on the number of cows that are to be milked, the number of people that are available for milking, the target milking time, the work routine of the operator/s, and the milk yield of the herd.
- Shorter work routines allow one person to milk more cows per hour, and can be achieved by: ensuring good cow flow into and out of the parlour, reducing row changeover times by releasing a row so that the first cows can be exiting while the last few clusters are changed and teat sprayed; using automation to replace tasks; and eliminating tasks (such as pre-milking teat preparation when cows are sufficiently clean).
- One person can handle a maximum of about 24 clusters at a peak yield of 22l per cow, without automatic cluster removers, but this requires extremely efficient routines and allows no time for pre-milking teat preparation. This number reduces to about 14 clusters when a full pre-milking routine is practiced.
- Increasing from one to two operators in conjunction with doubling the number of clusters, will in general double the parlour output per hour. The time it takes to load and unload a row of cows becomes the limiting factor in larger herringbone parlours making parlour design and cow flow even more critical to achieving the desired throughput.

Target outcomes for parlour performance

There are five main questions that should be asked when designing a new parlour or expanding an old parlour to accommodate a larger herd:

1. How many cows are to be milked?
2. How many people are available for milking?
3. What milking time is expected/acceptable?
4. How much milk will cows be producing on average at peak, and in late lactation?
5. What will be the predominant pre-milking routine?

The answers to these questions will determine parlour type, size (how many clusters), design (including automation) and ultimately the capital expenditure required.

How many cows are to be milked?

For many farmers that are expanding their herds, cow numbers will increase over a number of seasons. Therefore, it is important to size the parlour for the maximum number of cows that will be milked, or at the least allow space for additional clusters and extending cow handling facilities. Typically, in New Zealand, herringbone parlours are used for herds of up to 400 cows. Rotaries should be considered for larger herds if very high cow throughput rates per hour are required.

How many people are available for milking?

This decision should be part of the overall plan for labour on the farm. If the farm has two staff the parlour must be set up so that one person can comfortably milk the herd. This is because with only two people, allowing for time off and to keep within acceptable working hours, only one person will be available to milk the herd for over 50% of the milkings.

How long should milking take?

Total hours spent milking, total number of milking sessions and duration of milking sessions are all important to staff on a dairy farm. Two hours is often quoted as the maximum time one person should milk in a session. This has to be taken into account when deciding labour levels associated with milking which, will in turn be influenced by the milking routine that is used. Cow throughput rates for herds of 150, 250 or 350 cows, and for a range of milking durations, are given in Table 1. A throughput rate of 175 cows per hour is required for a herd of 350 cows to be milked in two hours. With just 250 cows the same throughput rate will mean milking will be complete in around 1.5h.

Table 1. Cow throughput (cows milked per hour) for a range of milking durations

Milking duration (cups on to cups off)	Herd size (cows)		
	150	250	350
	(Cows/hour)		
1 h	150	250	350
1.5 h	100	167	233
2.0 h	75	125	175
2.5 h	60	100	250

How much milk will cows be producing on average at peak and in late lactation?

Milk yield per milking has implications for the time it takes to milk a cow, which then influences the number of clusters one person can comfortably handle. For a mature herd peak daily milk production may be as high as 27l per cow per day, which is 16.9l per cow for the morning milking, assuming a 15h:9h milking interval. In many herds peak daily yields are around 22l, and peak yield at the morning milking, would be about 13.8l per cow. In late lactation yields will generally drop below 12l per cow per day which is as little as 4.5l per cow in the afternoon milking. The dramatic change in milk yield must be considered when determining parlour size, and whether automation, such as automatic cluster removers are necessary.

Example target outcomes for an expanding herd:

- Initially 150 cows, increasing to 250 within two years
- One person milking, with some assistance during particularly busy periods
- Maximum of 1.5 hours milking time (cups on to cups off)
- Peak yield between 22 and 27l/cow/d, late lactation yield of <12l/cow/d

Parlour size

Sizing the parlour to get the right balance between labour and equipment is a compromise, particularly in seasonally calving herds. This is because one person can manage a greater number of clusters at peak yields, without excessively over-milking cows, than they can late in the lactation, when cow yields have declined to less than half of their peak values.

Cluster throughput – how many cows can each cluster milk per hour?

The number of cows the equipment can milk in an hour is influenced by:

1). the time that a cluster is attached to each cow (the milk out time)

2). the time taken between removing the cluster from one cow and attaching it to another (the cluster idle time)

Together the milk out time and the cluster idle time make up the unit time.

In herringbone parlours the longest milking cow in each row limits row milk out times. Therefore maximum cow milk out times, rather than average cow milk out times, should be used to estimate row milking times. Examples of maximum milking times for yields of 10, 15 and 20l per cow are given in Table 2. A more comprehensive guide for maximum milk out times can be found at www.cowtime.au. For a peak yield of 22l and a 15:9h milking interval, the maximum milk out time for the morning milking (13.8l per cow) will be 8.0 minutes. The cluster idle time is usually about 15s (0.25min) in swing-over parlours, the most common parlour in use in Ireland, giving a unit time of 8.25 minutes.

Table 2. An estimate of milk out time, using the slow milking cow model, in seasonally calving herds (see www.cowtime.au)

Average cow yield per milking (L)	Milk flow rate of slow milking cows (L/min)	Maximum milk out time (min)
10	1.7	6.0
15	1.8	8.3
20	2.2	9.0

For a unit time of 8.25 minutes, the maximum cows that can be milked per cluster in an hour is 7.3, decreasing to 6.3 for higher yielding herds and increasing to nearly 14 in late lactation (Table 3).

Table 3. Maximum milk out time, cluster idle time, unit time and the maximum cows milked per cluster per hour at peak and late lactation

	Peak lactation		Late lactation
Daily yield (L/cow)	27	22	12
Peak yield (am milking)	16.9	13.8	7.5
Maximum milk out time (min)	9.2	8.0	4.1
Cluster idle time (min)	0.25	0.25	0.25
Unit time (min)	9.45	8.25	4.35
Cows/cluster/hr	6.3	7.3	13.8

The number of clusters that are required is equal to the number of cows to be milked per hour multiplied by the unit time divided by 60. For a herd of 250 cows with a peak yield of 22l per cow, and a target milking time of 1.5 hours, this is N = 167 (Table 1) * 8.25 / 60 = 23 clusters. For a smaller herd of 150 cows with the same peak yield, and a target milking time of 1 hour, this is 21 clusters.

Examples of theoretical equipment output rates for different parlour sizes and unit times are given in Table 4. For each unit time the output rate increases as the number of clusters increases. As the unit time increases, the output rate decreases, for a given number of clusters. In theory, a single operator 25 cluster parlour with a unit time of between 8.0 and 9.0 minutes can output between 167 and 188 cows/hour (see Table 4). This is close to the required 167 cows/h if 250 cows are to be milked in 1.5 hours. However, the actual output will depend upon the work routine of the operator (i.e., the milker throughput).

Table 4. Equipment output (cows/hr) calculated from the unit time and number of clusters (from www.cowtime.au)

Unit time (mins.)	Number of clusters				
	10	15	20	25	50
7	86	129	171	214	429
8	75	113	150	188	375
9	67	100	133	167	333
10	60	90	120	150	300
11	55	82	109	136	273
12	50	75	100	125	250

Milker throughput – how many clusters can one person handle?

The potential cluster throughput figures need to be adjusted to take account of peoples work routines. The main question that should be asked is how long does it take one milker to milk one cow? The work routine time is the time taken to carry out all the tasks required to milk one cow, and includes loading and unloading cows, pre-milking teat preparation, cluster attachment and removal, teat disinfection and any miscellaneous tasks such as reattaching clusters and washing cow standings. Table 5 gives examples of typical work routine times and predicted number of cows per operator per hour. The shorter the work routine, the more cows one person can milk per hour.

Work routine time can be reduced by ensuring good cow flow into and out of the parlour, reducing row changeover times by releasing a row so that the first cows can be exiting while the last few clusters are changed; using automation to replace tasks such as cluster removal and teat spraying; and eliminating tasks, such as pre-milking teat preparation, when cows are sufficiently clean. Most importantly, attention should be paid to preventing cows from becoming dirty so that the need to clean cows is minimised. Cows should return to pasture immediately after leaving the parlour, roadways must be well maintained (this will also help with cow flow from the paddock to the dairy) and the period of housing should be minimised.

Table 5. Predicted cows milked per operator per hour for three work routines (WR), (adapted from O'Donovan, 2008)

	WR 1	WR 2	WR 3
Cow entry (s)	3	3	3
Teat preparation (washing teats & drawing foremilk, s)	15	-	-
Cluster attachment (s)	10	10	10
Cluster removal (s)	5	5	-
Teat disinfection (s)	3	3	3
Cow exit (s)	3	3	3
Miscellaneous (s)	3	3	3
WRT (s)	42	27	22
WRT (min)	0.7	0.45	0.32
Maximum predicted cows/operator-hour	86	133	163

If the work routine time is less than 22s then one person can milk 250 cows in 1.5 hours. This is difficult to achieve and allows no time for cleaning or preparing teats for milking. If a work routine time of 27s is achieved (this would be typical of well run parlours using minimal teat preparation) then at peak lactation (8-9 minutes milking time) this would equate to around 20 clusters used to maximum efficiency. With a full routine, one person could not achieve the throughput required to milk 150 cows in less than 1.5 hours, regardless of parlour size.

Will increasing the parlour size further decrease total milking time?

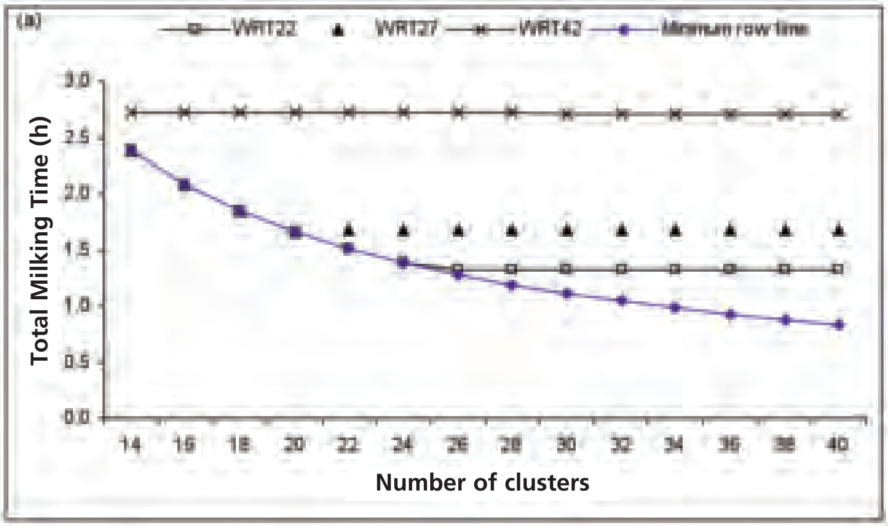
People often think that bigger is better. More cows, more clusters, less time milking. To a point, this is true, but when both the equipment throughput and the operator throughput have been maximised, more clusters will not lead to quicker milking times.

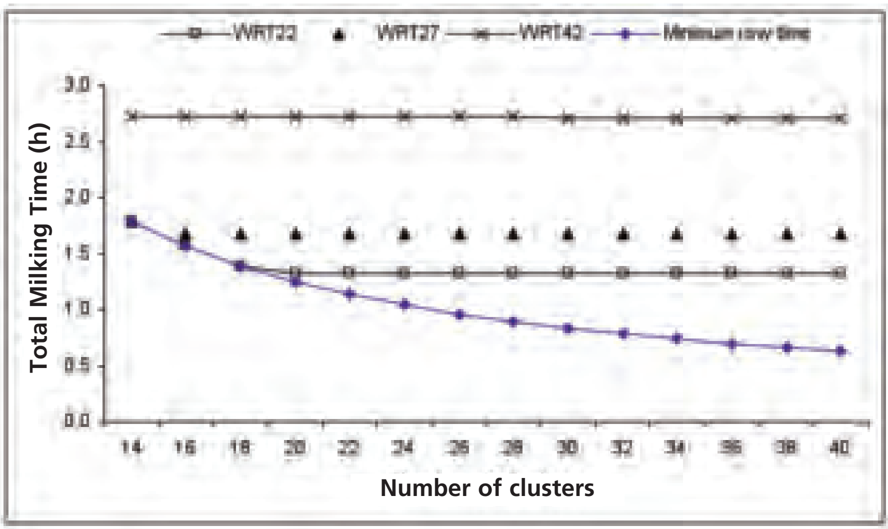
Parlour throughput with a single operator can only be further improved by reducing the work routine time and therefore allowing more clusters to be handled. Observations recently carried out on a number of Irish farms milking large herds showed that work routine times of around 30s were typical. The best operators achieved work routine times of 20 to 23s but these were the minority. Without reducing the work routine time, increasing the parlour size, will increase row times and the degree of over milking (if no automatic cup removers) which will counter any advantage achieved by the reduction in total number of rows.

The effect of work routine and parlour size on overall milking time can be seen in Figure 1. For a herd of 250 cows, and a work routine time of 42s, at a peak yield of 22l per cow, milking time is excessive for all parlour sizes. This is because work routine is limiting the throughput of the parlour. With a 27s work routine, which is typical of farmers milking large herds, milking time decreases as parlour size increases up to 20 clusters. This is because the operator is waiting for cows to milk out as equipment throughput has not been maximised. Beyond 20 clusters work routine time becomes limiting and as the number of rows decrease, row times increase, countering any potential efficiency gains. With an extremely efficient work routine taking just 22s, total milking time decreases with increasing parlour size up until 24 clusters.

In these scenarios the parlour has been sized for peak yields and maximum efficiency in terms of use of the equipment and minimising operator idle time. In seasonal calving herds' peak yields occur for only a short period of the season, therefore beyond peak, milking time reduces and over-milking will increase. Figure 1(b) shows that the number of clusters one person can handle, without over milking cows, reduces when the average herd yield declines from 22l to 15l. With a work routine time of 27s the optimal parlour size is now 16 clusters, increasing to 20 if the work routine time reduces to 22s. The use of ACR avoids any potential issues with over-milking of cows, and allows parlours to be sized for peak herd yields.

Figure 1. Total milking duration for three different work routines (22s, 27s and 42s) and a yield of (a) 22l per cow, (maximum milk out time of 8.0 min. at morning milking, 15:9h milking interval) and (b) 15l per cow (maximum milk out time of 6.0 min, at morning milking, 15:9h milking interval)





Cow throughput per hour can be increased by introducing a second operator and adding more clusters. As with single operator parlours the optimal number of clusters will depend on the work routine of the operators. In general, once the equipment throughout is maximised for a given work routine, doubling the number of clusters and introducing a second operator will double cow output. Critical to a successful two-person parlour is cow flow into and out of the parlour and both operators working together as a team. To reduce the time between rows, both operators should start cupping from the front of the parlour. In this way the row can be released earlier than if one operator started at the front of the row and the other half-way down the row. Beyond about 40 clusters the time it takes to load and unload a row becomes a limiting factor in large parlours, leading to issues with overmilking and reducing efficiencies. Walking distance can also become an issue for operators.

Current milking performance on farms with large herds

Milking performance data from thirteen Irish spring-calving herds ranging in size from 164 to 481 cows is shown in Table 6. All of the parlours were swing-over herringbones and ranged in size from 14 to 44 clusters. One morning milking was observed between September and December 2009 when the spring-calving herds were producing between 10 and 15l/cow/day (i.e., mid- to late lactation).

The data shows that the larger parlours are milking double the number of cows as the smaller parlours, in the same overall milking time. However they are achieving this using more people and therefore the cows milked per operator per hour is similar.

There was a trend towards a greater proportion of cows being over-milked as parlour size increased. However, there were also examples of extensively over-milked cows amongst the smaller and medium sized parlours. Over-milking is a concern because it may affect teat condition and udder health. The proportion of teats scored as rough or very rough, increased with increasing parlour size, consistent with the increased severity of over-milking observed as parlour size increased.

Table 6. Milking efficiency measures and teat condition for herds milked in small, medium or large herringbone parlours

	Parlour Size		
Milking performance measure	**Small (14-20 clusters)**	**Medium (24-32 clusters)**	**Large (42-44 clusters)**
Number farms	4	6	3
Cows	203 (164-238)	252 (178-343)	354 (332-381)
Clusters	17 (14-20)	27 (24-32)	44 (42-44)
Rows	11 (8-16)	9 (8-13)	8 (8-9)
Total milking time (h)	1.4	1.5	1.3
Cows/h	129	177	268
WRT (s)	27	36	27
Operators	1	1.7	2
Cows/operator/h	133	112	134
Cows/cluster	11.9	9.4	8.2
Row time (min)	7:33	9:29	9:46
% cows over-milked#	42	57*	77
% teat ends rough or very rough	9	18	26

 # % of cows with clusters removed more than 2 minutes following end of milk flow.
** Excludes one parlour with ACR*

There were several situations observed that lead to over-milking of cows: waiting for slow milking cows to milk-out which then caused a delay in detaching clusters from cows in the next row; the time taken to release and empty a row of cows in larger parlours; and extended pre-milking routines which prevented operators removing clusters from cows that had ceased milk flow. Automatic cluster removers prevent over-milking however many farmers are reluctant to adopt this technology due to cost and a belief that they will reduce efficiency as operators must pick up clusters each time they attach a cluster to a cow, rather than simply carrying the cluster over after detaching it from the cow in the opposite row. The use of automatic cluster removers is increasing in other low-cost dairy regions. In Australia 33% of swing-over parlours have ACR (Watson, 2009) and in New Zealand 55% of rotary parlours and 9% of herringbone parlours have installed ACR (Cuthbert, 2008). An alternative to automatic cluster removers is to reduce the number of clusters that are in use as the lactation progresses, or adopt a system that lowers the vacuum when milk flow falls below a set level.

New Zealand dairy farms

New Zealand dairy farmers are often viewed by Irish farmers as extremely efficient. The average size of herringbone parlours in New Zealand is 24 clusters with a median herd size of 270 cows (Cuthbert, 2008). The maximum size of single operator herringbone parlours is 26 clusters. The average number of cows per cluster is 11.7 (i.e., 12 rows). For herds between 250 and 350 cows, the average herringbone parlour size is 26 clusters (range = 16 to 40), and the majority of farms have two people milking at peak lactation.

Key features of New Zealand parlours and milking practices are: parlours designed for cow flow (e.g., straight through exits, backing gates); minimal pre-milking routines; increasing use of automation (drafting units, teat sprayers and automatic cluster removers); a trend towards rotary dairies as herd size increases beyond 400 cows; establishment of a second herd for mastitis and lame cows.

Concluding comment

Determining the optimum parlour size requires thought about the overall goals of the farm, including the utilisation of labour, and potential herd size in the future. While there are many things to consider, the importance of an efficient routine is paramount to achieving a high number of cows milked per person.

Acknowledgments

The input of the following people that contributed to the preparation of this article is acknowledged: Dr Bernadette O’Brien and Dr Dave Gleeson, internal reviewers, as well as Finola McCoy who assisted with on-farm data collection.

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Reseeding Non-Productive Pasture - a Sensible Investment

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Summary

- Dairy farmers should reseed 10 – 15% of their farm annually to ensure their pastures are dominated by perennial ryegrass.
- To identify poor yielding paddocks within a dairy farm weekly grass measurements need to be completed.
- Spring is the most reliable time to complete reseeding; if reseeding in autumn it should be completed by early August.
- Paddocks reseeded in spring have a greater total annual DM yield in the year of reseeding than unreseeded old permanent pastures.
- When selecting grass mixtures dairy farmers should differentiate between varieties suitable for grazing and silage.
- In the future, it is hoped that grass varieties will be selected based on the 'Grass Economic Index' which will assign economic values to grass varieties based on seasonal DM yield, total DM yield, quality and persistency.

Investing in new pastures is as important as investing in the animal's genetics. Ensuring that the dairy farm has a high level of perennial ryegrass is key to increase grass utilisation and farm profit; an extra one tonne of grass utilised is worth €200/ha. When you visit the Greenfield farm or any other profitable dairy farm it is worth noticing the quality of pastures available to the dairy herd. Achieving good performance from grass is dependent on having high quality perennial ryegrass/clover swards. This article will outline the important aspects of reseeding pasture, what's happening at farm level, why and when reseeding should be completed, its benefits and costs.

What is happening at farm level?

In 2009, Teagasc Moorepark, surveyed a proportion of Kerry, Connaught Gold and Glanbia suppliers on the level and method of reseeding employed on the farm. These were the main findings:

1. Regular reseeding took place on 50% of farms, 25% reseed infrequently and 25% of suppliers never reseed.
2. Of those reseeding, 50% reseed 2-4ha/year; 20% <2ha/year.
3. 75% of suppliers prioritise the grazing area for reseeding.
4. Increased spring/autumn DM production and improved sward quality were identified as a benefit to reseeding.
5. 66% of suppliers reseeded in autumn, 13% in spring and 21% did a combination of both.
6. Only 50% of the participants soil test the area being reseeded.
7. 50% plough, 20% use minimum cultivation, 30% use a combination of both.

8. When seeding, 40% use the fertilizer spreader, 35% seed barrow.
9. Post-emergence spray was used on 50% of farms.
10. 85% of participants swards were infected by docks; directly linked to low usage of post-emergence spray and timing of reseeding.

In general, the results of the survey were encouraging in that farms which are reseeding are experiencing good results and consider it a good investment.

Poor performing paddocks are reducing profitability on dairy farms

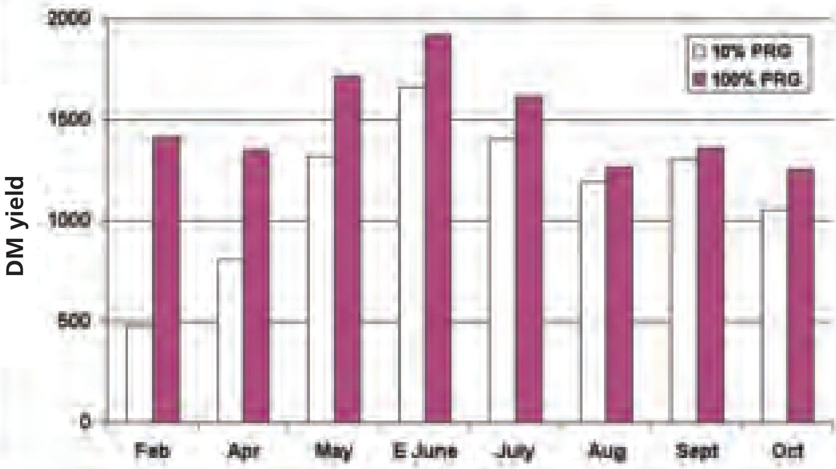
Table 1 shows the annual grass DM production for 17 farms in the Munster region for 2009. While the overall grazing platform stocking rate is high at 2.6 cows/ha, the variation in grass DM production is large across the farms. The difference in annual grass DM production between the highest and lowest farm is 5.2t grass DM/ha. Much of this difference is due to the variation in the proportion of perennial ryegrass in swards. **Table 1** also shows large variation in grass DM production within farm; top 20% of paddocks producing on average 13.4t DM/ha while the 20% lowest producing paddocks producing on average 8.2t DM/ha. A targeted reseeding programme will increase the DM production of the lowest 20% of paddocks. Farmers should be aspiring to produce 16t DM/ha, depending on soil type and stocking rate.

Table 1. Mean and range in Grass DM production on seventeen dairy farms in 2009

Farm location and soil type	Average DM production	Top 20% of paddocks	Bottom 20% of paddocks	Stocking rate (Cows/ha)
Tipperary (Free draining)	14.4	17.0	9.5	3.0
Limerick (Heavy soil)	13.4	14.5	11.4	3.1
Tipperary (Free draining)	12.8	14.3	10.1	2.5
Cork (Free draining)	12.4	14.6	10.6	2.9
Tipperary (Heavy soil)	11.9	15.0	8.0	2.2
Cork (Free draining)	11.7	14.5	8.3	2.5
Cork (Heavy soil)	11.0	13.5	7.1	2.7
Cork (Free draining)	11.0	13.2	8.5	2.1
Cork (Free draining)	11.0	12.9	8.5	3.1
Cork (Free draining)	10.9	13.2	8.4	2.6
Tipperary (Heavy soil)	10.2	13.3	7.5	2.2
Cork (Free draining)	9.9	13.3	6.3	2.7
Tipperary (Free draining)	9.6	11.7	7.5	2.5
Cork (Free draining)	9.4	12.8	7.2	3.3
Cork (Heavy soil)	9.3	11.5	6.0	2.0
Cork (Heavy soil)	9.2	11.9	7.7	2.2
Cork (50:50 heavy/free)	9.2	11.0	6.3	2.7
Average DM production	**11.0**	**13.4**	**8.2**	**2.60**

Perennial ryegrass pasture will not alone increase DM production but will also increase pasture quality and nutrient use efficiency. Recent research in Moorepark has shown old permanent pasture to be on average 3t DM/ha lower in DM production to swards that have 100% perennial ryegrass. Figure 1 shows the dry matter contribution across the grazing season of a 10% perennial ryegrass sward compared to a 100% perennial ryegrass sward. The majority of the difference in DM yield between the two swards is accounted for in the spring period (i.e., up to the mid-May). Swards with low levels of perennial ryegrass are nutrient inefficient, 25% less nitrogen responsive than swards with high levels of perennial ryegrass. If a longer grazing season is an objective it will not be achieved with pastures with low levels of perennial ryegrass. Swards with a low proportion of perennial ryegrass are reducing profit per hectare by **€300** due to reduced DM production. In general pastures with <65% perennial ryegrass should be reseeded.

Figure 1. Dry matter distribution with 10% perennial ryegrass compared to 100% perennial ryegrass swards



Perennial ryegrass is the most productive and nitrogen responsive grass species available. Invasions of other species especially annual meadow grass takes place due to the availability of a huge number of seeds in the soil profile. Ensuring adequate pH (6 to 6.5) and P and K levels will minimise the invasions of weed grass (Agrostis, Yorkshire Fog, Annual Meadow Grass).

A major issue on farms is the lack of planning for reseeding, farmers should be able to pin point the paddocks that are not performing and target those for reseeding. At the start of each year a proportion of the lower producing paddocks should be targeted for reseeding in that year. On heavy soils the drainage should also be assessed and if it requires investment then this should be completed as part of the reseeding programme. In these type of soils autumn reseeding is too risky, this work should be completed in spring/early summer.

Comparison of reseeding methods

In Moorepark last year a number of reseeding methods were compared with a spring reseeding. The following reseeding techniques were compared:

(i) Control – permanent pasture
(ii) Plough, level and one pass reseed
(iii) One pass reseed
(iv) Direct drill
(v) Disc and one pass reseed
(vi) Sprayed off with Reglone and direct drill

All swards were initially sprayed with Roundup. Cultivation and reseeding took place on 7 May and the initial grazing took place on 2 July. DM production was measured across the year pre spraying-off and also after cultivation to document the cumulative DM production for the year. Grass DM production for the treatments were: Control - 9.8t DM/ha; Plough, level and one pass – 9.5t DM/ha; One pass – 10.9t DM/ha; Direct drill – 10.7t DM/ha; Discing and one pass – 9.8t DM/ha; Spray-off with Reglone and Direct drill – 10.1t DM/ha.

These results clearly show that although the reseeded areas were out of production for almost three months their annual dry matter production was similar, if not greater than the control area which was accessible for the entire year. Additional DM yield benefits of reseeded swards will also be realised in subsequent years compared to non-reseeded areas. Little difference was found between reseeding methods, although there is still weed grasses present in the Reglone treated pastures. The choice of cultivation method will depend on soil type, degree of stoniness and proximity to machines. In 2010, the DM production of the various reseeding methods will be monitored.

Timing of reseeding

From the survey information it is evident that up to 70% of farmers reseed during the autumn period, while this makes sense from a feed budget point of view, it does have some negative effects. The previous three autumns have been difficult for reseeding. If planning to reseed this autumn, then it should be completed in early August. This will give enough time to apply a post emergence spray and possibly obtain two grazings from the new pasture pre-closing. Over 50% of farmers who reseed in autumn, don't apply post-emergence sprays. This is mainly due to lack of time to spray post-sowing in the autumn, consequently 90% of surveyed farms have dock problems. Reseeding in early autumn is generally successful as soil temperatures are well above the threshold soil temperature for growth which is (8°C) for clover and (6°C) for grass.

The target turnaround time in which to get a reseed back into production should be 60 days. Generally, farmers are slow to reseed pastures because they view the non productive period as being too long. The time that the sward is out of production can be minimised. Obviously prevailing weather conditions dictate this, it is better to minimise the non productive period.

Reseeding cost

Reseeding is a medium-term investment (Table 2). Swards renovated in 2010 can be expected to last for 8 to 10 years or longer if correctly managed. Such swards will be required to sustain management changes to the dairy system over that time period. The costs reported here are similar to those detailed by the survey participants throughout the country.

Table 2. Conventional Method Reseeding costs 2010
In general, farmers estimate cost of reseeding at €200/acre, which is realistic as some of these costs outlined above are carried in the overall management of the farm.

	€/acre
SprayingGlyphosate (Gallup 360) (Round-up (2 litre/acre)	10 16
Ploughing (€30)/ Till & sowing (one pass)(€30)	60
Fertiliser (2 bags x 10:10:20) Fertiliser Spreading	47 10
Levelling	10
Rolling	10
Grass seed	45
Post emergence herdicide sprays Alistell – (1.5litre/ac -€30) Legumex DB - (2.8litre/ac - €18) Duplosan - (1 litre - €9/ac)	 30 18 9
Spraying	10
Costs (excl. post-emergence sprays –depends on what farmers choose to use)	**218**

Choosing grass varieties

Varieties differ in their suitability for different management systems. A recent three-year study, funded by DAFF and completed in Moorepark in November 2009, shows that the management imposed on a variety significantly influences its dry matter yield and quality performance. Four managements were imposed; one representing a simulated grazing system, the other three managements represented a 1-cut, 2-cut and 3-cut silage system. The simulated grazing system incorporated 10 defoliations from March to November. The 1-cut silage system imposed seven defoliations from February to October including one silage cut. The 2-cut silage system imposed six defoliations from late March to October including two silage cuts and the 3-cut silage system incorporated five defoliations from late May to September with three silage cuts.

Table 3 shows the change in the rank order of the varieties relative to the mean DM yield (t DM/ha) depending on which management they are exposed to. In the simulated grazing system, Bealey and Tyrella were the two highest yielding varieties. When the number of silage cuts increased in the 2-cut and 3-cut silage systems, these two varieties were outperformed by other varieties and their position in the Table dropped significantly. Malone performed poorly in the simulated grazing system, but re-ranked as the number of silage cuts increased and was the highest yielding variety in the 3-cut silage system.

These results highlight that certain varieties are suited to grazing-only systems, while other varieties are more suited to use in silage systems. The evidence of re-ranking of cultivars based on their total DM production highlights the need to ensure that grass varieties are evaluated using the optimum protocol to represent the current and anticipated future needs of the industry.

Table 3. Effect of management system on ranking of varieties across a three-year period relative to the mean DM yield

Rank	Simulated grazing (11.7 t DM/ha)		1-cut silage (13.4 t DM/ha)		2-cut silage (15.1 t DM/ha)		3-cut silage (15.3 t DM/ha)	
1	Bealey	1.06	Tyrella	1.03	Dunluce	1.05	Malone	1.07
2	Tyrella	1.05	Navan	1.02	Arrow	1.05	Portrush	1.04
3	Arrow	1.03	Bealey	1.02	Lismore	1.02	Alto	1.04
4	Dunluce	1.02	Lismore	1.01	Greengold	1.01	Lismore	1.00
5	Alto	1.00	Dunluce	1.00	Malone	1.01	Greengold	1.00
6	Dunloy	0.99	Greengold	1.00	Navan	1.01	Navan	0.99
7	Navan	0.99	Malone	0.99	Glencar	1.01	Arrow	0.99
8	Glencar	0.98	Glencar	0.98	Bealey	0.98	Glencar	0.98
9	Malone	0.97	Dunloy	0.97	Alto	0.98	Bealey	0.98
10	Greengold	0.97	Alto	0.97	Tyrella	0.97	Tyrella	0.98
11	Lismore	0.97	Arrow	0.97	Portrush	0.96	Dunluce	0.97
12	Portrush	0.96	Portrush	0.97	Dunloy	0.96	Dunloy	0.96

Grass Economic Index

A Grass Economic Index allocates an economic value to grass varieties that will reflect their profitability within a grass based production system. The most important variety characteristics for herbage production are seasonal DM yield, total DM yield, quality and persistency. In areas of seasonal grassland production there is generally a deficit in grass availability at the shoulders of the season and surplus grass is available during the main grazing season. The availability of grass and the demand for it fluctuates across the season, resulting in changes in the economic benefit of additional grass in the system. Cultivars with high winter and spring growth rates would make a large economic contribution to grass based systems as they would reduce the concentrate and silage feed costs in the system during periods of grass deficit e.g., early lactation/spring. Therefore the resulting economic weighting on grass production will have increased emphasis on out-of-season growth and less focus on high DM yields during the main growing season when grass supply generally exceeds demand. The selection of grass varieties with higher seasonal growth alone will not necessarily result in a superior grass on the farm. Other factors such as persistency and quality as well as silage DM yield must also be considered.

Key traits of interest in grass production including DM yield, sward quality and persistency can contribute significantly towards overall profitability within the farm system. Economic values were derived by simulating a physical improvement for each trait of interest independent of all other traits (improved spring, summer and autumn DM yield, higher grass DMD value from April to September (inclusive), improved persistency and increased silage (1st and 2nd cut) yields. The final Economic Value (EV) for a variety is reported on a € per ha per year basis.

In order to derive economic values the Moorepark Dairy Systems Model (MDSM) was used to simulate herd parameters, nutritional requirements, land use and total inputs and outputs. The base milk price used in the model is assumed at 27 c/l based on long term projections. The model parameters were investigated through the application of the economic values to actual production data. The production values, generated by twenty grass varieties which were managed under a simulated grazing protocol and also a 2-cut simulated conservation protocol across a three-year period.

Table 4. Economic value per unit change in each trait of interest: DM yield, quality, silage yield and persistency

€/ kg change in DM yield	**Spring 0.27**		**Summer 0.03**		**Autumn 0.16**	
€/unit change in DMD per kg	**April 0.01**	**May 0.02**	**June 0.02**	**July 0.02**	**August 0.02**	**September 0.02**
€/kg change DM silage yield	**1st cut 0.09**			**2nd cut 0.06**		
€/ % change in persistency per ha	**4.96**					

The economic value for spring DM yield is based on the financial benefit of each 1kg increase of grass DM yield in the spring. An increase in grass growth and hence an increase in grass available to the cow reduces the requirement for silage or concentrate during this period with no effect on milk production. The value for autumn DM yield is based on the same principal as that for spring yield. The lower value for summer DM yield occurs as a result of grass not being limiting during this period, therefore each kg increase in DM yield is less valuable to the system. The economic value for quality expressed per kg, is based on a 1% change in DMD and is calculated on a monthly basis. The economic values of each variety to a grazing system are shown in Table 5. Persistency data is not included. Based on a 10-year reseeding plan any variety which has a shorter lifespan and is therefore less persistent will result in a decrease of €4.96 per percentage change in persistency per hectare per year. Work is currently being carried out at Moorepark to assess persistency of varieties. Until data is available on the persistency of a variety, no economic value will be included in the economic index for persistency. It is envisaged that Moorepark will introduce persistency data into the index in the near future. Silage remains an important part of the diet of ruminants during the winter period. The economic value for silage is based on a kg increase in silage DM yield above the average of all varieties for both 1st and 2nd cut.

Table 5. Ranking of varieties based on economic values applied to grazing parameters of 20 varieties

	€ DM yield			€	€/ha per year
Variety	Spring	Summer	Autumn	Quality[1]	Grazing EV[2]
Bealey	121.3	9.0	16.0	101.3	248
Dunluce	50.4	5.4	-17.6	111.9	150
Tyrella	70.5	8.0	21.9	29.4	130
Dunloy	-9.3	-3.4	14.7	127.1	129
Navan	-4.0	-3.9	4.8	107.9	105
Arrow	153.3	-0.9	-27.9	-33.8	91
Greengold	31.3	-5.9	-34.3	77.6	69
Glencar	25.2	-1.3	-31.6	70.5	63
Alto	114.1	-8.7	-15.0	-52.3	38
Malone	38.2	-7.3	-33.2	31.3	29
Aberdart	-10.3	5.6	42.6	-19.5	18
Aberavon	-74.9	15.7	63.0	-0.9	3
Lismore	-2.4	-1.0	-49.0	51.3	-1
Portrush	-8.9	-6.6	-33.4	-9.4	-58
Fennema	-41.3	-0.2	13.0	-72.2	-101
Foxtrot	-87.3	4.8	30.0	-59.8	-112
Mezquita	-67.1	14.2	29.6	-109.3	-133
Melle	-82.4	-9.2	22.3	-106.9	-176
Twystar	-87.6	-3.4	11.6	-115.5	-195
Corbet	-128.7	-10.8	-27.5	-128.9	-296

[1]Quality value is a sum of the April to August DMD values, no data available for September
[2]Economic values (EV) relate to grazing value only for inclusion of silage EV see Table 4.
**No persistency data is available and therefore persistency is excluded from the calculations. Therefore results must be treated with caution as the final EV for a variety could alter significantly depending on the persistency of the variety.*

Table 6 presents the total economic values of the 20 varieties including a value for 1st and 2nd cut silage. If a farmer is using a variety for grazing only the values can be obtained from Table 5 to identify the varieties which will give the greatest economic contribution to the grazing system. If silage is also to be cut, Table 6 presents the economic values for a system combining a 2-cut silage and rotational grazing system.

Table 6. Ranking of varieties based on the economic values applied to grazing and silage parameters of 20 varieties*

	€ DM yield			€	€ DM yield silage		€/ha per year
Variety	**Spring**	**Summer**	**Autumn**	**Quality[1]**	**1st cut**	**2nd cut**	**Total EV**
Bealey	121.3	9.0	16.0	101.3	-28.6	-1.9	217
Dunluce	50.4	5.4	-17.6	111.9	24.2	35.5	210
Tyrella	70.5	8.0	21.9	29.4	10.2	-1.5	139
Greengold	31.3	-5.9	-34.3	77.6	22.6	29.1	120
Navan	-4.0	-3.9	4.8	107.9	-2.5	17.9	120
Dunloy	-9.3	-3.4	14.7	127.1	-30.9	14.8	113
Arrow	153.3	-0.9	-27.9	-33.8	5.8	16.2	113
Glencar	25.2	-1.3	-31.6	70.5	2.2	27.4	92
Lismore	-2.4	-1.0	-49.0	51.3	59.4	11.6	70
Malone	38.2	-7.3	-33.2	31.3	31.7	-1.9	59
Alto	114.1	-8.7	-15.0	-52.3	-0.3	1.8	40
Aberdart	-10.3	5.6	42.6	-19.5	-1.7	-32.1	-15
Aberavon	-74.9	15.7	63.0	-0.9	-3.9	-16.5	-18
Portrush	-8.9	-6.6	-33.4	-9.4	-18.2	8.2	-68
Foxtrot	-87.3	4.8	30.0	-59.8	20.8	0.3	-91
Fennema	-41.3	-0.2	13.0	-72.2	45.8	-44.8	-100
Melle	-82.4	-9.2	22.3	-106.9	-16.4	-13.	-206
Twystar	-87.	-3.4	11.6	-115.5	-11.7	-17.6	-224
Mezquita	-67.1	14.2	29.6	-109.3	-74.2	-21.7	-229
Corbet	-128.7	-10.8	-27.5	-128.9	-34.1	-11.9	-342

[1]Quality value is a sum of the April to August DMD values, no data available for September
**No persistency data is available and therefore persistency is excluded from the calculations. Therefore results must be treated with caution as the final EV for a variety could alter significantly depending on the persistency of the variety.*

Overall, the objective of the Grass Economic Index is to introduce the value of each variety into the National Recommended List for Grass Varieties in conjunction with the Department of Agriculture, Fisheries and Food. This will provide clear guidelines to farmers on the potential economic value of each variety to their system as a whole. If silage is an important factor the farmer can focus on the silage EV (e.g., from **Table 6** it is clear that the varieties Dunluce and Lismore performed well under a silage system). Whereas if spring grazing is considered more valuable then varieties which provide a EV that is highly positive for the spring DM yield value can be identified. It is recommended that when selecting varieties, farmers should look at all the data and identify the varieties most suited to their system based on grazing DM yield, silage DM yield, quality and persistency. The underlying objective of the Grass Economic Index is to allow farmers have more confidence in choosing varieties that are suitable to their respective systems.

Greenfield Farm Design

Padraig French, Adrian Van Bysterveldt, Laurence Shalloo and Brendan Horan

Introduction

For the past 25 years, milk quota has been the most limiting factor to expansion for Irish dairy farmers, however in the foreseeable future access to capital is likely to constrain growth to a much greater extent than milk quota. The objective of the business is to maximise the return while farming in an environmentally and animal friendly manner, while at the same time maximising labour efficiency. The focus of the investment in the Greenfield farm has been to minimise capital investment in non-productive depreciating assets such as farm buildings and machinery while ensuring that investment in areas that will affect productivity is not compromised such as stock, high performing pastures and grazing infrastructure.

The capital cost breakdown for each item of expenditure is detailed in Table 3 of the 'Greenfield Projections' paper by Shalloo *et al* in this booklet. The key areas that will require capital investment include:

1. Farm layout, roadways and water supply
2. Reseeding
3. Farmyard layout
4. Milking parlour

1. Farm layout, roadways and water supply

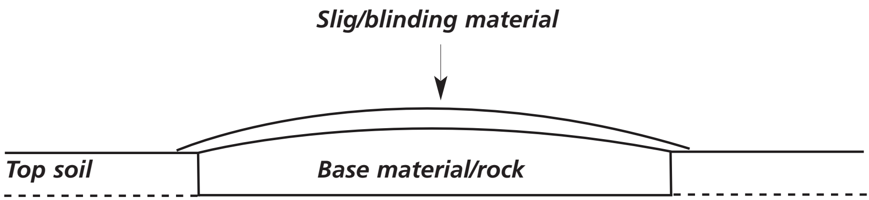
Figure 1 shows the original layout of the farm while **Figure 2** shows the new paddock and roadway layout. The farm was designed with 28 paddocks – mostly in 4 ha size to facilitate 24-hour grazing for a herd of 350 cows. Most ditches were removed to allow size and shape requirement to be met. The paddocks are set up to be rectangular to square in shape and have longest frontage along the races if they are in the wetter areas of the farm. Paddock shape was designed to facilitate stock movement into and out of the paddock i.e., stock move down hill to exit paddocks. The farm roadways are set up to follow the contour and were designed to remove extreme bends. The main paddock gateways are angled to the race at 45° with at least two gateways for each paddock off the race. There is one wire (electrified) fence between paddocks with interconnecting gateways between adjacent paddocks, two wires (electrified) are used where extra security is needed. The electrified fences are divided into sections with easy to access cut off switches.

The farm roadways were constructed for the fast stress free movement of 350 cows and some heavy vehicle traffic. The aim was to provide a wide, dry smooth surface where cows move along easily and so reduce travel time to and from the milking parlour.

Main traffic areas
This is the first 1km in each direction from the milking parlour and were constructed as follows:

1. Removed top soil to a width of 5 to 6m.
2. Laid base material and shaped to give a curved surface that will shed water onto the farmland along side but still be flat enough for the cows to walk across the whole surface.
3. Compacted with a large vibrating roller (greater than 5t) to a minimum height above ground level of 100ml at the outer edges and 150ml in the centre of the roadway.
4. Allowed to settle.
5. Cover with a 75mm – 100mm layer of slig/blinding material and compact with a very large vibrating roller.

Cross section of roadway (end view)



It is important to have the race surface and the concrete of the collecting yard at the same level. The placement of a low (6" or 150mm) concrete nib wall at the junction of the race and the yard will mean that less stones are kicked or carried from the roadway onto the yard. This is very important in reducing the risk of lameness due to stone injuries. All corners on the farm roadways are gently rounded so as not to slow stock movement.

Low traffic race areas
The race construction is similar to that in the main traffic areas except that the base material is laid directly on top of the ground. The width and all other aspects are the same. This reduces the cost of construction but this part of the race will not stand up to as much heavy traffic use as the method of construction used closer to the farm yard. The surface finish is exactly the same as in the high traffic areas. It is essential that no water is allowed to pool on the race surface. Timely maintenance is essential and the main job is to remove any build up of material at the sides of the race that will prevent water running off.

Water
The design of the water flow can be seen in **Figure 3**. The main water line flowing through the farm is a 40mm MDPE pipe with branch lines to the

troughs of 32mm diameter MDPE pipe and all branches are less than 100m long. The water troughs are mostly 500 gallon concrete units, are rectangular in shape and are across two adjacent paddocks where possible. All paddocks have access to two troughs and all are fitted with full flow ball valves to allow 30 litre fill capacity per minute. The main water line was laid along the side of the races for most of the farm with taps at all major junctions. There is a water flow meter and an inline dispenser fitted at the milking parlour.

2. Reseeding and fencing

Sward variety selection has already been covered in 'Reseeding non-productive pasture - a sensible investment' by O'Donovan *et al*., in this booklet. See **Figure 4** for varieties used throughout the farm. This land has been a very well managed tillage farm for a long time, soil fertility was regularly monitored and a min-till option has been used in recent years to help improve soil organic matter.

The soil fertility status was assessed by splitting the land into recognisable blocks and from each block soil samples were taken which were then pooled into a block sample for testing. Soil fertility was addressed based on soil tests and the lime was applied as required prior to tilling. A min-till option was used for reseeding so that the ground would be firm going into the first winter. The swards were grazed-off when at a low cover of 200kg DM/ha available (pre-grazing yield) to promote tillering.

3. Farmyard layout and structure

Figure 5 shows the farmyard layout and structure. The overall objectives when designing the farmyard was to provide a facility that could adequately milk and accommodate up to 350 cows in a labour efficient manner and minimise capital investment in the entire farmyard to less than €1,000/cow. The milking parlour and other farmyard facilities were situated to be approximately central within the farm (considering current and future needs). The milking parlour, silage slab and standoff pad were sited where the land slope is suitable and favours easy drainage to lagoon. The yard was designed to allow plenty of space for vehicle movement around all of the farmyard infrastructure.

The wintering facilities on the farm comprises of a 4,200m^2 out-wintering-pad (OWP) which will provide adequate lying area for 350 cows @ 12m^2/cow, an 87m long head feed area at which approximately 150 cows can feed simultaneously. An earth lined slurry store (ELS) which has a net storage capacity of approximately 3,000m^3 or approximately 19 weeks of slurry storage based on 160m^3/week of expected slurry production during the winter months. The out-wintering-pad (OWP) and earth lined slurry store (ELS) are constructed in an area of the farm that is underlain by subsoil with relatively high clay content (>15%) and this subsoil met the specifications for an earth lined OWP and ELS. An artificial liner for both the OWP and ELS would have increased the capital costs by approximately €50,000.

It is intended that most of the calvings will take place on a designated area of the OWP, however, a small shed will be constructed (10m x 6m) on the OWP to facilitate catching and handling of cows at calving and to provide shelter to newborn calves during periods of inclement weather. It is also intended that all calves will leave the farm within two weeks of birth with all male calves being sold and dairy replacement heifers sent to a contract rearer. A mono-pitch calf shed with five separate pens, each with capacity for 12 to 15 calves will be constructed with each pen having isolated air and effluent movement. Five individual isolation pens of similar design will also be built.

4. Milking parlour

Milking parlour and collecting yard layout are shown in **Figure 6**. In order to minimise labour, a strong focus of the design was to optimise cow flow around the milking parlour as approximately half of the entire labour on this farm will be used in the milking process. The entrance race to the parlour provides an unobstructed 7m wide direct line to the back of the collecting yard. The circular collecting yard has a 13m radius to provide adequate space for 350 cows in three-quarters of the circle and the motorised backing gate is plumbing to facilitate automatic washing of the collecting yard. The bail area and drafting area is designed to speed cow movement into and out of the parlour and to facilitate a simple drafting system. In-parlour feeders were not installed as they would disrupt cow flow, increase the cleaning-up time and increase the capital cost. When cows will require concentrate supplementation they will be fed out on the wintering pad.

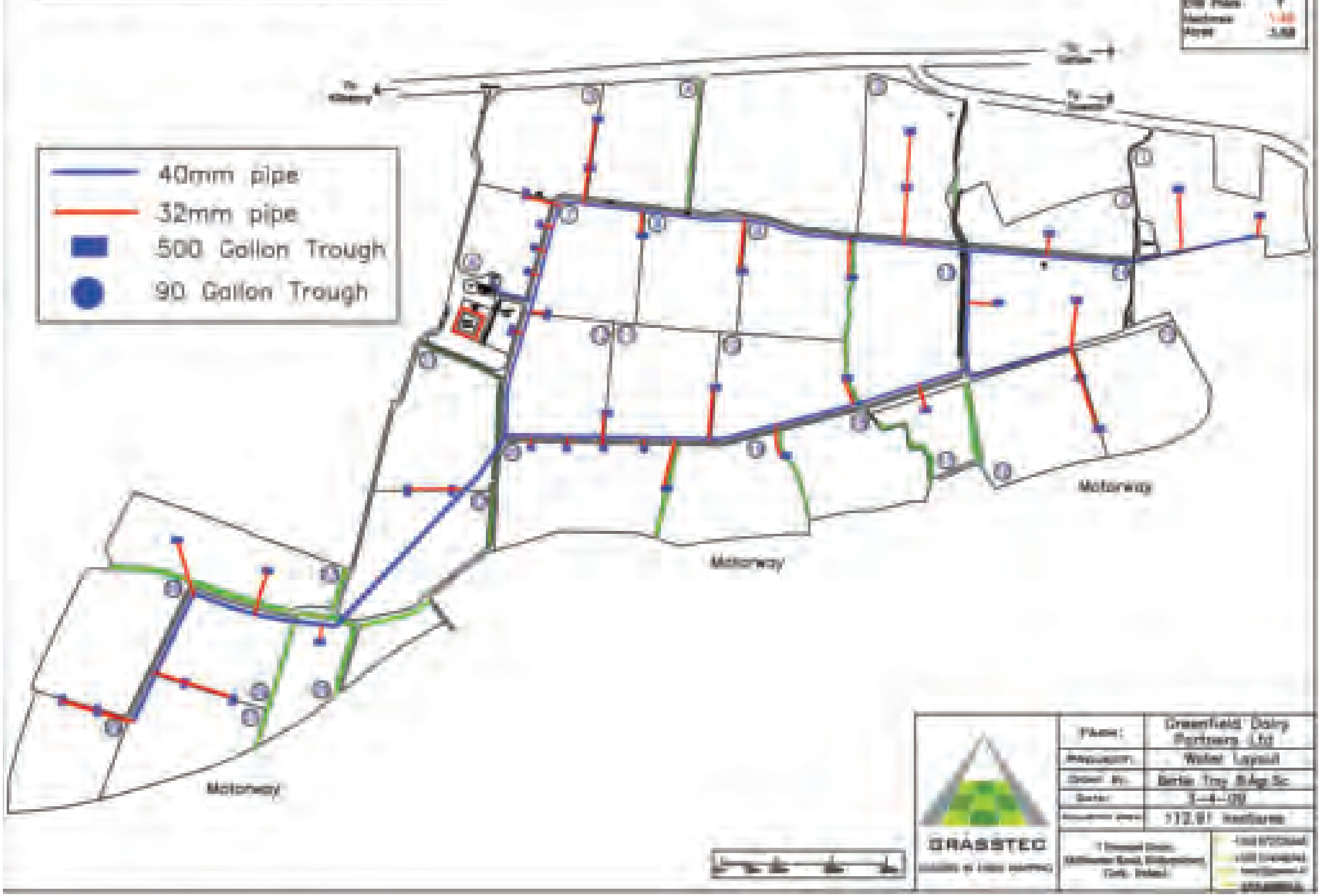
A dump-line was not installed as it is considered best practice from a milk quality perspective for large (if not all) herds to operate a second herd of 'unhealthy' cows which may have mastitis, lameness or other ailment which required antibiotic treatment. A number of paddocks have been designed close to the parlour to facilitate a small 'unhealthy' herd. A separate herd of colostrum cows will also operate during the calving season. An industrial plate cooler is installed through which cold water will be pumped directly from the 50m deep bore well at 6,000l/h during milking and this will be stored in the 25,000l water reservoir before being used for pumping to stock and wash down of the bail area. Further cooling of the milk will be done in the 22,500l direct expansion tank with two 7.5hp compressors. The tank will provide adequate storage for five milkings from 350 cows peaking at 25l/day and is a purpose built outdoor tank to reduce the capital cost of the shed. The farm also has a 3-phase power supply at a capital cost of €10/m for the approximate 600m required to the 3-phase line with a connection fee of €3,700. The main power requirements on the farm are the two bulk tank compressors, a 10hp vacuum pump, two 1.5hp milk pumps, and three 1.5hp water pumps.

It is planned that as much as practically possible, the machinery work on the farm will be undertaken by contractor to optimise labour and management efficiency and to minimise capital investment. All of the silage harvesting and feed-out, fertilizer and slurry spreading, cultivation and reseeding and stock transport will be undertaken by contractors. For all other farm work a small tractor and loader, a spreader for applying cal-mag and a tractor mounted feeder for feeding out concentrate will be purchased. The total capital investment in machinery will be less than €20,000.

Fig. 1 - Original Farm Layout

Fig. 2 – New Paddock & Roadway Layout

Fig. 3 – Water Layout Map



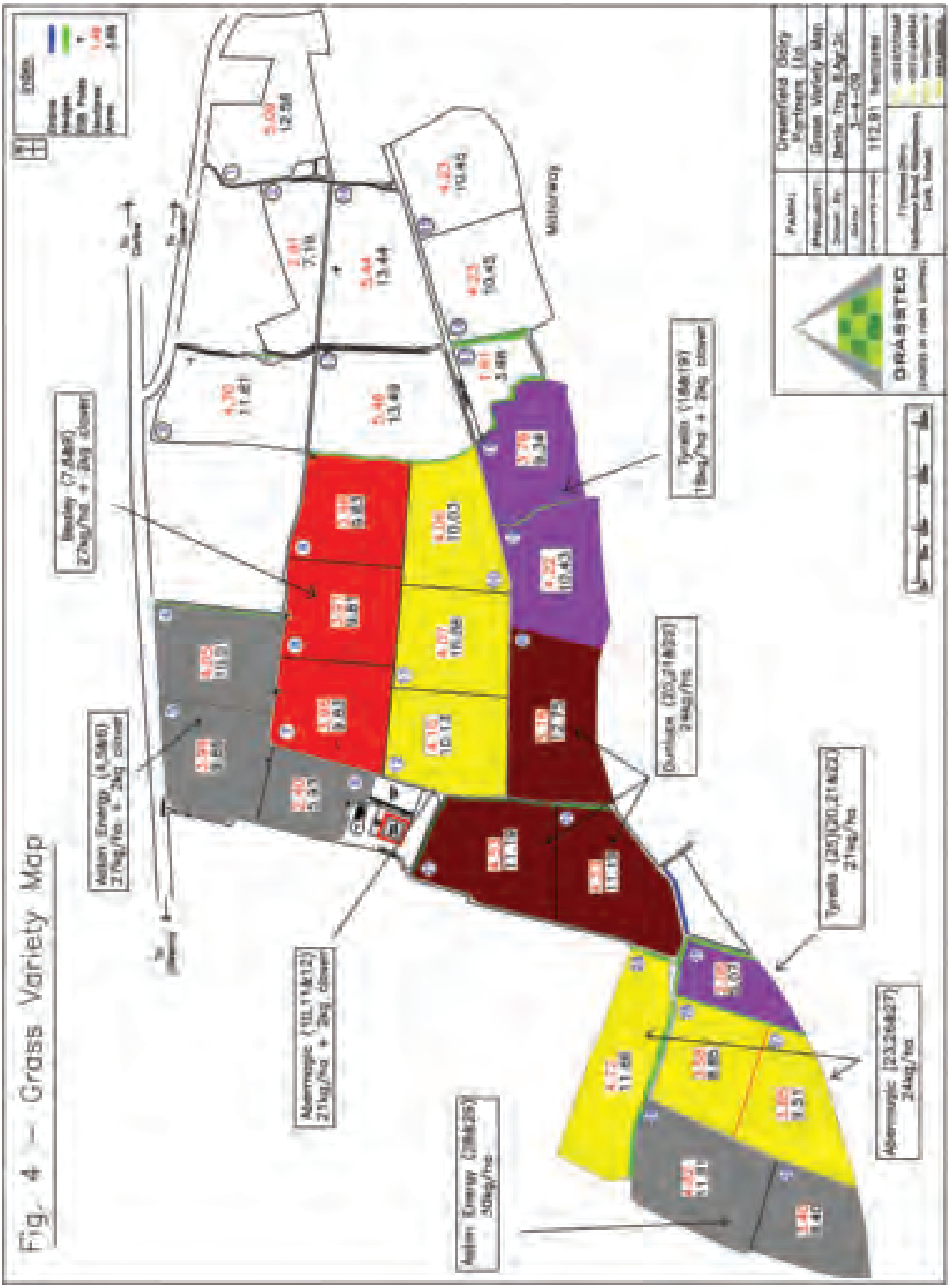


Fig. 4 – Grass Variety Map

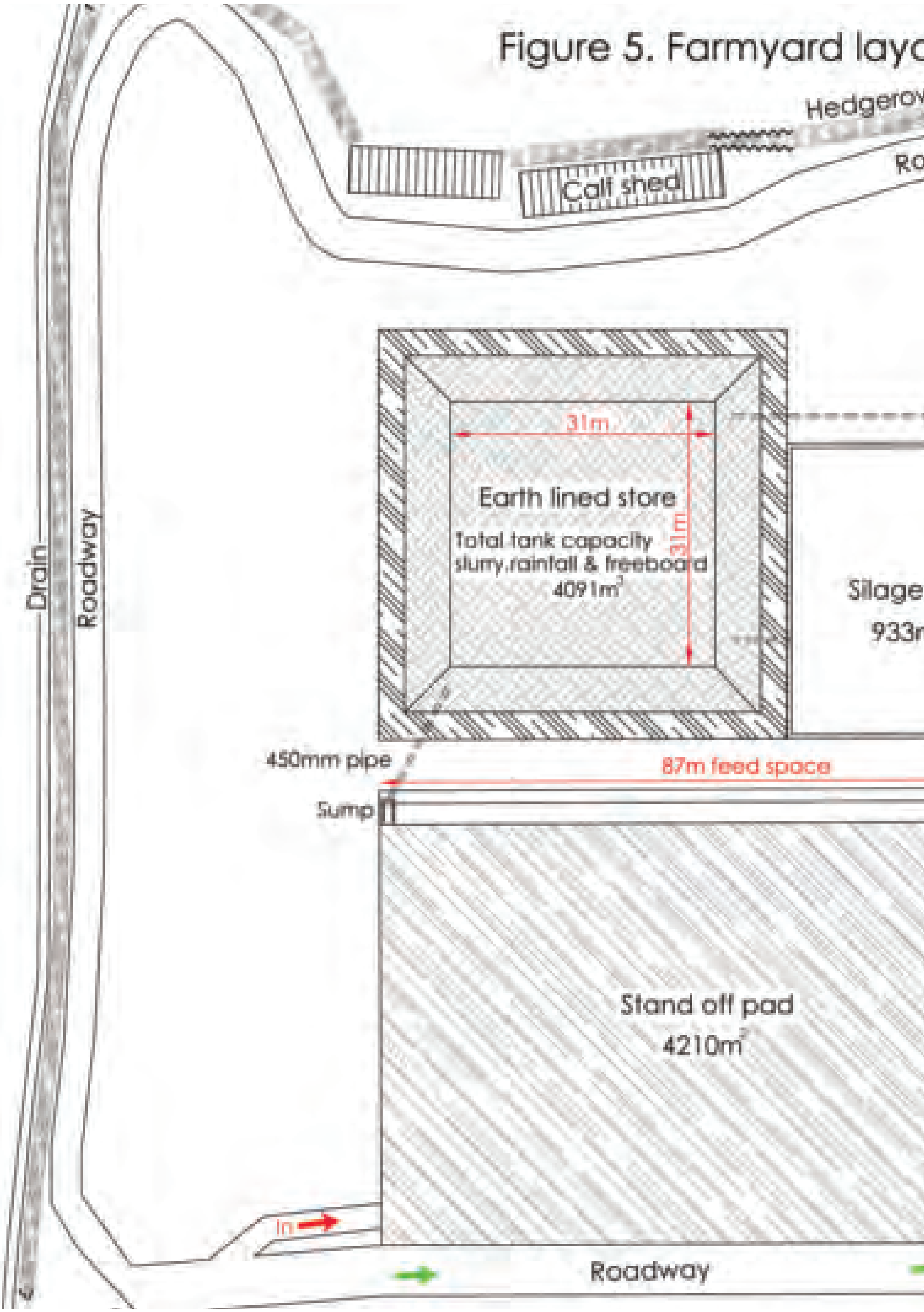


Figure 5. Farmyard layo
Hedgerow
Calf shed
Ro
Earth lined store
31m
31m
Total tank capacity
slurry,rainfall & freeboard
4091m³
Silage
933r
450mm pipe
87m feed space
Sump
Drain
Roadway
Stand off pad
4210m²
In
Roadway

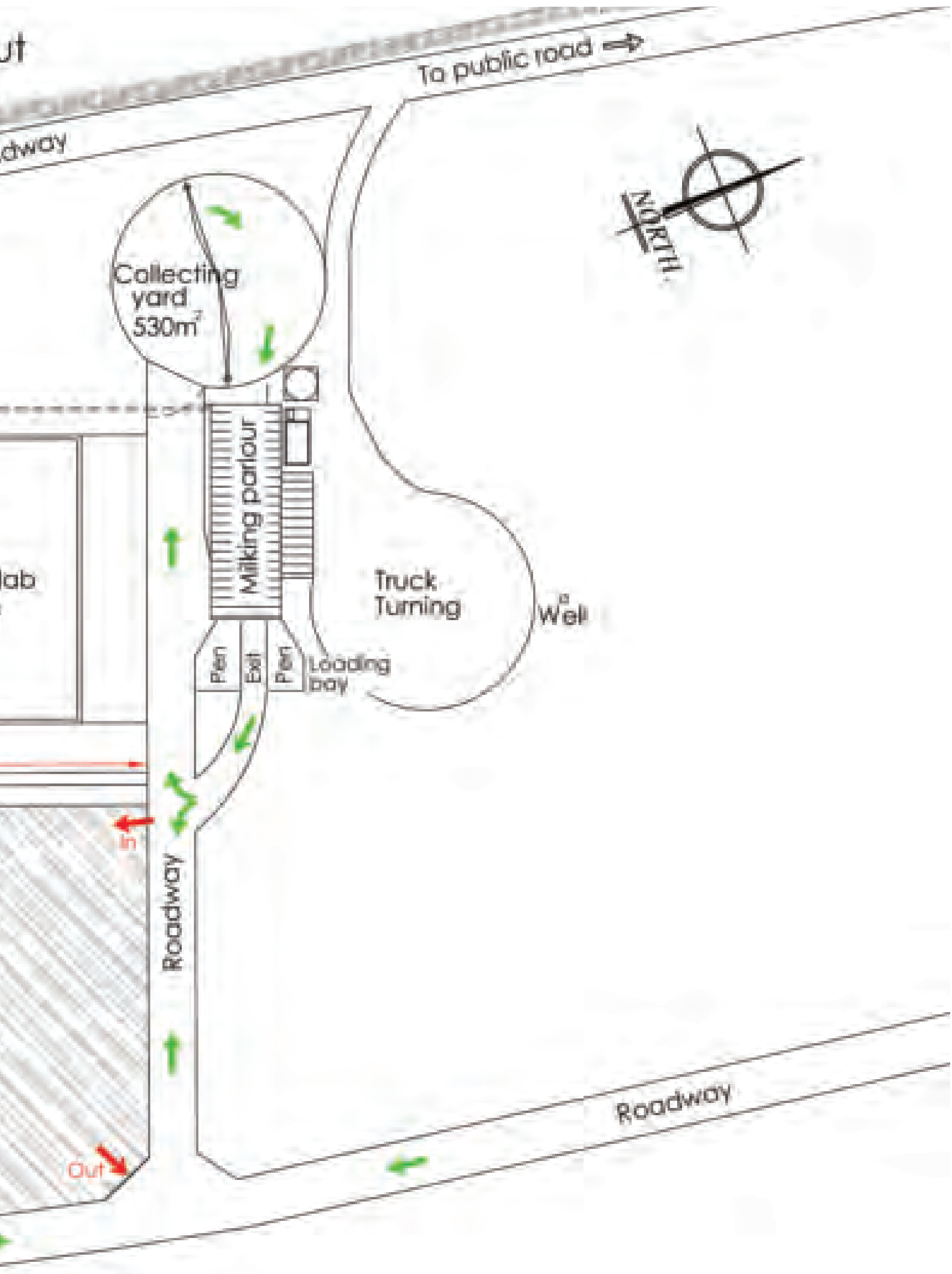
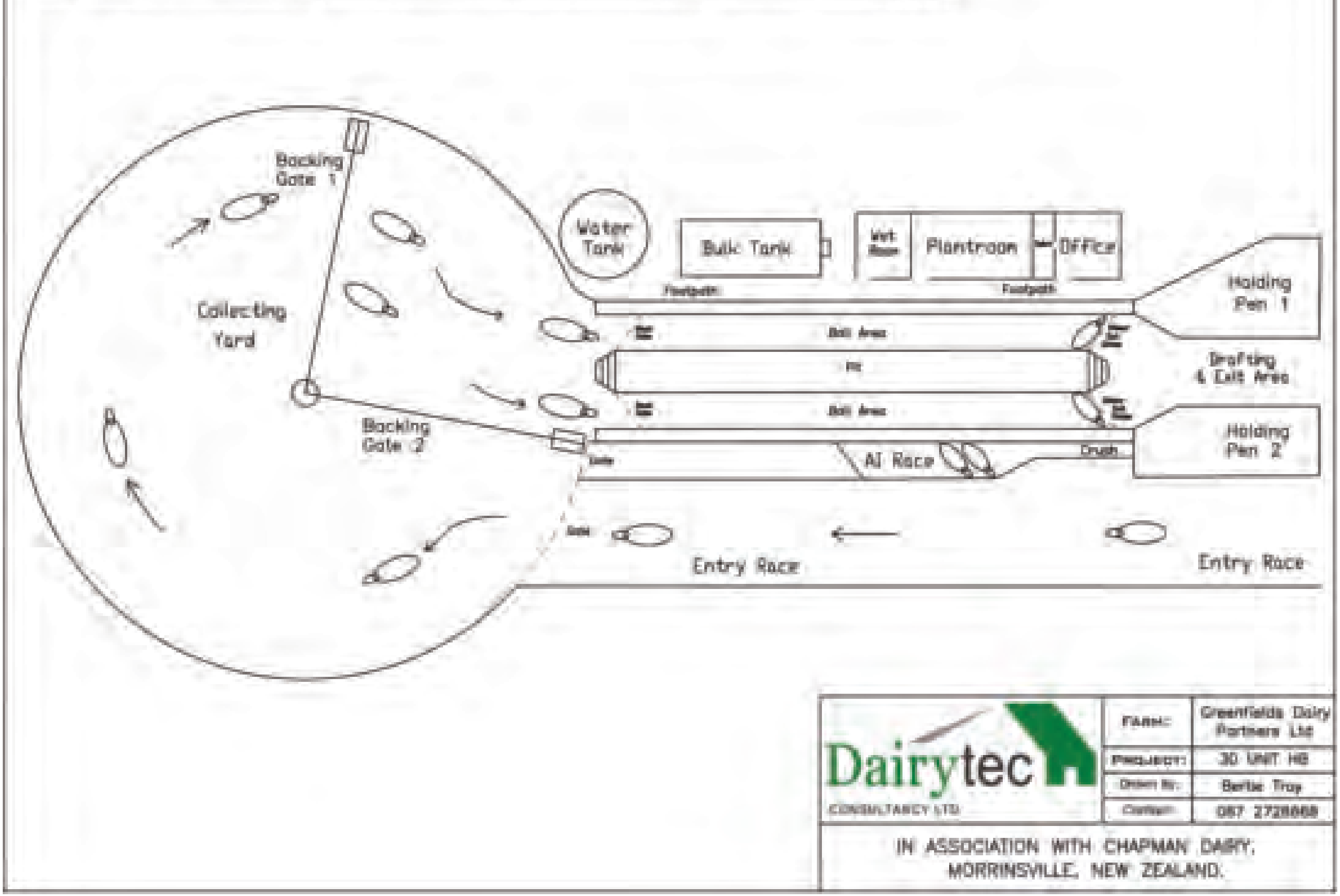

To public road
Collecting yard 530m²
Milking parlour
Pen
Exit
Pen
Loading bay
Truck Turning
Well
NORTH
Roadway
Roadway
In
Out

Fig. 6 – Milking Parlour & Collecting Yard Layout



Notes

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