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Teagasc National Dairy Conference 2013

Strategies for Sustainable Success

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Contents

What can your dairy farm do for you?

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Summary

The majority of milk produced in Ireland in 2020 will be produced on family dairy farms. While the income requirements of family dairy farms will depend on circumstances, there is the potential to generate income from dairy farming of almost €98,000 for a 100-cow unit adopting best practice. The family dairy farm will provide an opportunity for the dairy farmer to earn a return on the investment in land, labour and capital but only if (1) the farm is operating efficiently and (2) the level of investment is limited to €3,000 - €4,000 per additional cow. The availability of additional cash following expansion will likewise be influenced by the level of efficiency, the amount borrowed and the interest rate. Successful dairy farmers will be required to be technically proficient as well as expert at business management with an absolute clarity around what they want from life and from their dairy farming business.

What will a family dairy farm look like in 2020?

The Irish dairy industry is changing. In the future there will be more milk produced by fewer suppliers. Improved technologies, better genetics and better management practices will allow this to happen. Successful dairy farmers will need to be technically proficient as well as expert at business management. They will need to be clear on their reasons for producing milk while also understanding how their expansion plans will deliver on these reasons. They will need to think, plan and act on what they want their farm to be like in five to ten years time. If they don't, they will have no one to blame but themselves.

The majority of milk produced in Ireland in 2020 will be produced on family farms. A family farm[2] is a farm owned and operated by a family, where the family makes the important management decisions, and the family provides most, if not all, of the labour (it may use seasonal labour during peak periods and a reasonable amount of full-time hired labour). The farm produces enough income (including off-farm employment) to pay family and farm operating expenses, pay debts, and maintain the farm. The family considers the needs of the land, the animals, the farm, as well as the needs of the family, in making all decisions. It is not unrealistic to expect that a dairy farming family will have a target income – an amount of income it desires for a particular period (usually a year). This target will reflect a mix of the family's needs and aspirations. Needs are driven by the number of farm dependents while aspirations are driven by desired living standards and for family farmers the deep-seated desire to see their children keep on the tradition of farming. Needs and aspirations (but mainly needs) drive behaviour.

Target income will vary depending on circumstances. So while every farmer's target income will be different, one thing we do know is that it will rise over time due to changing circumstances (e.g. increased education costs) and inflation. As a guide, the CSO Household Budget Survey of 2009 – 2010[3] indicates that the average weekly household expenditure for a family in a rural location is €773 per week for a household of 2.95 persons (of which 0.69 persons are 0 – 13 years of age). Not all family dairy farmers will be full-time dairy farmers, nor will they all depend on dairy farming as the only income source in the household. Teagasc NFS figures for 2012 suggest that 51% of dairy farm families have off-farm income (47% of spouses have an off-farm job). Direct payments also contribute to household income. Teagasc NFS figures for 2012 indicate that total direct payments for the average dairy farmer amounted to €21,232 including €17,054 Single Farm Payment. The final source of household income is State Transfers e.g. Children's Allowance. While acknowledging the four potential sources of income for a family dairy farm, the remainder of this paper will focus on the income generated by farming activities.

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1 I would like to acknowledge the help of Teagasc colleagues Thia Hennessy, Seamus Kearney and George Ramsbottom in preparing this paper.
2 Ikerd, J. (2006) 'Sustaining the family farm'. Available at http://web.missouri.edu/ikerdj/papers/Lethbridge-Family%20Farms.htm
3 CSO (2010) 'Household Budget Survey 2009 – 2010'. Available at http://www.cso.ie/en/media/csoie/releasespublications/documents/housing/2010/0910first.pdf

As the target income for a family dairy farm household changes over time, it follows that the scale of the family dairy farm will also change over time. However, I believe that the family dairy farm does have a future and that the majority of milk produced in 2020 in Ireland will be produced on family dairy farms, provided that the dairy farm is built on a strong and sustainable strategic foundation.

By 2020, I foresee that a typical family dairy farm will have the following characteristics:

- 50 – 55 hectares farmed
- 80 - 100 dairy cows
- 25 replacement units
- 41,000 kg MS produced (530,000 litres @ 7.5% F + P %)
- 2.25 – 2.50 LU/Ha stocking rate
- One full-time labour unit plus family/ casual labour at peak times plus contractor

Increasingly family dairy farms will be specialised in dairy only, will have invested in infrastructure and facilities and will rely on family and casual labour at peak times. Larger family dairy farms will manage greater than 150 cows with the help of hired labour and contractors and will look to contract rearing, partnerships, share farming and other collaborative arrangements to streamline their business.

Your dairy farm can generate income

So what level of income could this farm potentially generate in 2020? There will be many variables in this calculation including milk price, the costs of milk production, the level of investment on the farm and the amount of hired labour employed.

Assuming 100 dairy cows selling 41,000 kg MS at a base price of 29.5 cent per litre (excluding VAT) results in milk revenues of almost €190,000. Total production costs include both variable and fixed costs and are estimated to be €3.30/kg MS and €2.60/kg MS for the 'good' and 'best' dairy farmers in 2020 respectively. Subtracting total production costs from milk sales suggests a dairy income figure of €54,120 and €82,820 for the 'good' and 'best' dairy farmers in 2020 respectively.

Table 1: Potential dairy income from 100 dairy cows producing 41,000 kg MS in 2020

	€	€
Milk Sales (41,000 kg MS @ €4.60 kg MS)	189,420	189,420
Less Total Production Costs	@ €3.30/ kg MS 135,300	@ €2.60/ kg MS 106,600
Dairy Income	54,120	82,820

What are the reasons for this variation? After all both farmer are producing the same product. The answer lies in the cost of production (and more importantly the margin) and the volume of milk produced at that cost/ margin:

(Outputs x price/ unit - Inputs x price/ unit) x Volume

Profitable, and sustainable, farming is about efficiency. It is about creating a margin on the milk produced and optimising the volume of milk produced for the capital employed (land, labour and capital). It follows that there are two ways to increasing profit from dairy farming: (1) by increasing the margin per kilogram of milk solids sold (efficiency) and (2) by increasing the volume of milk solids sold (expansion). While improving efficiency won't come without some costs and investment, often in the form of learning a new skill, it does represent a far less risky route to increased profit than expansion. Efficiency must always come before expansion (or better before bigger). Making an inefficient system bigger will only burn up more of your money.

Your dairy farm can provide you with a return on your investment

Many dairy farmers will make significant investments in their businesses once EU Milk Quotas are removed. Indeed many have already invested; Teagasc NFS figures suggest that the average new investment over the five year period 2008 to 2012 was €17,533 per farm. On-farm investments can be grouped into two categories:

Category 1 investments include animal genetics, knowledge, reseeding, soil fertility, infrastructure (roadways, water), labour saving modifications and tend to give a higher return on investment; and

Category 2 investments include buildings, slurry storage, machinery and land and tend to give a low return on investment.

As the amount of funds available for investment will be scarce, dairy farmers must critically assess each investment and judiciously use available funds. Category 1 investments must be prioritised over Category 2 investments (in most cases) and in particular, farmers must ensure that funds aren't over invested in Category 2 at the expense of investment in Category 1. Buildings and machinery depreciate; investments in stock/ cows and land improvements don't. Remember that when you make an investment, you are choosing to invest while you are also choosing not to invest in something else. So you choose. You need to ask yourself a number of questions about your proposed investment: "Will it lower my costs of production?" "Or increase my profits?" "Or create more time?" "Or create more opportunities in the future?" "Will it expose me to things outside my control that equal risk?"

A useful measure to evaluate an investment is the return on investment (ROI) ratio. ROI is a measure of the return to the total capital employed, irrespective of whether the capital is owned or borrowed. It can be calculated as:

ROI = (Net Income + Interest paid – Unpaid labour charge) / Total Investment

The following table summarises the ROI for a range of investment costs and anticipated future profit margins.

Table 2: Return on Investment (ROI) for a range of total investment costs and profit per additional cow

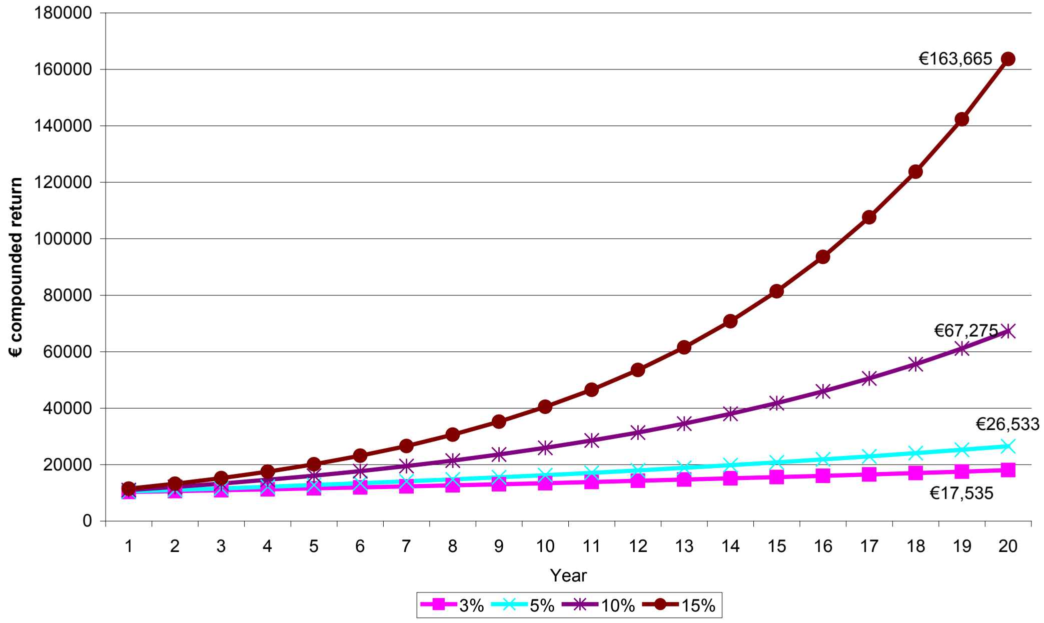
Investment costs, €/ cow	Profit per additional cow, €					
	300	400	500	600	700	800
2,000	3.8	8.8	13.8	18.8	23.8	28.8
4,000	3.7	6.2	8.7	11.2	13.7	16.2
6,000	3.7	5.4	7.1	8.7	10.4	12.1

Assumptions: Unpaid labour charge of €300 per cow. Money borrowed @ 6% over 15 years for average annual interest repayments of €75, €149 and €224 for investments of €2,000, €4,000 and €6,000 respectively.

Higher margins will generate higher returns on investment for a given level of investment while the returns are higher for the lower initial investment in all cases. The importance of achieving consistent high returns (10% +) and continuing to reinvest the surpluses generated in high return areas is emphasised by the diverging lines in Figure 1 below.

For an initial investment of €10,000, the compounded annual returns amount to €17,535, €26,533, €67,275 and €163,665 after 20 years for annual rates of return of 3%, 5%, 10% and 15% respectively. The difference is staggering and the gap only gets wider as time passes. We know that pasture-based dairy farming systems have the potential to generate high returns on investment as does investment in the technologies which allow the dairy farmer to maximise grass growth and utilisation e.g. increasing P and K levels, reseeding, improved grazing infrastructure. If expansion is to be pursued, dairy farmers must carefully invest their available finances (savings and/ or borrowings) in items which will yield a high return on investment (a minimum target of 10% ROI is suggested). All too often the reduction of income tax or the promise of a 'hoped for', but poorly proven, performance improvement or capital gain is used as a justification for an investment decision. Being absolutely clear about the 'destination' for your farm business will help you decide between the various investment options. Remember that you choose your investments and most are reasonably inflexible i.e. you cannot easily re-sell a building/ slurry storage facilities/ milking parlour, so a poor decision will be with you for a long time. Irish dairy farming cannot afford poor investments and unnecessary debt, which could all too easily happen in the exciting times ahead. Dairy farmers will face huge challenges to make the right investment decisions, in a period of great excitement, and much talked about opportunities.

Figure 1: Compounded returns on €10,000 initial investment at four different rates of return over 20 years



Your dairy farm can generate a cash flow

My colleague, Kevin Connolly, will outline the differences between net profit and cash flow. A good production year (high milk price, lower than expected costs) will result in an once off cash surplus (referred to as discretionary or free cash flow by Kevin Connolly) which is available for re-investment, consolidation/ cash reserve or personal expenditure. The challenge for dairy farmers will be to ensure (1) a cash surplus or a minimum level of cash deficit on an annual basis; and (2) an adequate cash reserve to protect against the year where there will be a cash deficit. An efficient farm enterprise will maximise the chances of generating a repeatable cash surplus.

It is vital that every dairy farmer knows the additional cash which will be generated as a result of a decision to increase cow numbers. Table 5 (at the end of this paper) shows how the expected additional profit, amount borrowed and interest rate interact to influence the level of cash available after loan repayments have been met. The 'base' option (# 4) involves 'good performance' (€1.30 expected profit per kg MS) combined with a moderate level of investment (€3,000 per cow including the cost of the cow) and a low interest rate (4%). The best option involves a combination of 'better performance' (€2.00 expected profit per kg MS) with a moderate level of investment (€3,000 per cow) and low interest rate (4%). The three best options all include improved performance – even though two of these options involve a higher interest rate (#2) and higher investment (#3). The two poorest options involve 'good performance' (€1.30 expected profit per kg MS) combined with either a high level of investment (€5,000 per cow) or both a high level of investment and a high interest rate (8%). Both options result in no additional cash being available following principal repayments and additional labour costs. While the figures highlight the importance of performance/ efficiency, it also highlights that the scale of the investment (€3,000 v €5,000) has a bigger impact on the available cash than the interest rate (4% v 8%). The message therefore is that you must be an efficient farmer and watch the level of investment you plan to make if you are to have cash available following your herd expansion.

Farm debt represents a financial risk to a farm business. For this reason it must be expertly managed. Debt servicing is a fundamental part of cash flow and with lower returns debt servicing can impact on family drawings and a farm family's standard of living. With increased volatility in milk price (and returns) likely, fixed debt commitments will increase the exposure of the farm business to risk. Learning to live with and manage uncertainty about finances in a positive way is key to a high quality of life for dairy farmers. Strategies include talking about financial issues openly as a family; working with a financial consultant or adviser to conduct a regular/ annual financial analysis of the farm business; completing a monthly cash flow budget at the start of the year and recording all transactions as they occur; developing short- and long-term goals for your farm business; developing a good relationship with your bank manager and developing a business management team to help you make the right decisions for your business. Your Teagasc Dairy Adviser can help you with a number of these strategies.

Your dairy farm can grow more grass to feed more cows

Research has shown that it is possible to grow and utilise more grass than is currently the case on the majority of dairy farms. Table 3 shows the impact of grass grown and utilisation rate on farm carrying capacity. By increasing the grass grown from 8 to 12 tonnes DM per hectare, it would be possible to carry 50 per cent additional cows on the same land area. By additionally increasing the utilisation of the grass grown, a further 12 additional cows (60 per cent increase in cow numbers) could be carried. Alternatively, a smaller land block (38 hectares or 37 per cent less land) with higher annual growth rates and utilisation could carry the same number of cows.

Table 3: The impact of grass grown and % utilisation on farm carrying capacity

	Farm A	Farm B	Farm C	Farm D
Farm area, Ha	60	60	60	40
Grass grown, tDM/Ha	8	12	12	12
Utilisation	75	75	80	80
Grass utilised, tDM/Ha	6	9	9.6	9.6
Total grass utilised, tDM	360	540	576	365
Potential cows	79	118	126	80
Assumptions: 5tDM required per cow per year. 500 kg concentrates fed (425 kgDM) per cow				

How is this possible? It starts with establishing your current position and then setting a target of growing and utilising more grass on your farm. You must then identify and remove the factors limiting grass growth on your farm. These can include: soil fertility (P, K and lime), drainage, under-performing swards, poor infrastructure, nitrogen and poor management decisions. Given the relationship between grass utilised and profit, dairy farmers must focus on growing and utilising more grass as a priority.

Your dairy farm can provide you with a sustainable future

Your dairy farm can deliver a sustainable future for you and your family. While sustainability can mean different things to different people, Teagasc defines sustainability as a 'multi-dimensional concept embracing economic, environmental and social measures'. Although there can be some debate over the appropriate measures to use, recent Teagasc research suggests that dairy farmers tend to perform well relative to farmers in other enterprises under the three measures. Experience would suggest that there will be just as much variation, if not more, between dairy farmers on the measures listed. So the challenge will be to examine the sustainability of your own farm under the economic, social and environmental headings and identify areas for improvement.

Compared to other farming enterprises, dairy farming can provide you with a higher income with less reliance on direct payments. It can offer a positive environment for raising a family, the opportunity to live in the country, the ability to take a few hours off during 'normal' work hours (you are your own boss after all) and the instant reward and feedback that comes from the frequent bulk milk tank collections and monthly milk statements[4].

4 Parlour profiles: dairy farmers talk about their lives; available at http://www.extension.umn.edu

Table 4: Performance of dairy farmers under a selection of sustainability measures (Source: Teagasc NFS)

Economic measures

- Highest gross output per hectare
- Highest income per labour unit
- Least dependence on subsidies as part of overall income
- Highest percentage of economically viable farms (sufficient income to compensate family labour and provide a 5% return on capital invested in livestock and machinery)

Social measures

- Second least number of vulnerable households
- Highest level of education
- Highest viable demography (household is deemed viable if farmer is less than 55 years of age and if over 55 another household member is less than 45 years of age
- Poorest work/ life balance (highest number of hours worked on the farm in a typical day

Environmental measures

- Least amount of Greenhouse Gases (GHG) per hectare
- Second highest level of GHG per € output net of subsidies
- Highest level of energy efficiency (€ of expenditure on electricity and fuel per € of output net of subsidies)
- Highest levels of total N (chemical and organic) per hectare

Critical Success Factors for your family dairy farm

In this final section, I will list what I believe are the Critical Success Factors for successful and profitable dairy farming in the future.

1. There are many technical and financial benchmarks talked about in relation to dairy farming. However, there are two which must take precedent over all others: tonnes grass utilised per hectare and return on investment.
2. Be clear on what you want from life and from your dairy farming business. Many dairy farmers lack this clarity and as a result decisions become difficult and confusing. Clarity gives you a framework against which you can assess all subsequent options or opportunities. The best dairy farmers have this clarity of focus and have identified what drives their business forward.
3. Be business minded and pay attention to both planning and monitoring. Start by benchmarking your current performance and then set goals/ objectives for your business, your career and your family/ personal life. Having drawn up your plan, you can then set about implementing it while continuing to monitor progress against your goals over time.
4. Have the right cow for your farming system. Given that the comparative advantage of milk production in Ireland involves the efficient utilisation of pasture, then the appropriate cow must be able to harvest grass effectively. In all cases, this will be a high EBI cow with a high fertility sub-index. Cross-breeding has the potential to add up to an additional €180 profit per cow in addition to the value of improved EBI.
5. You must aim to grow and utilise the maximum amount of grass from your land base. Getting soil fertility right (index 3 for both P and K and pH of 6.3 for most soils) and addressing drainage where needed will allow your farm to grow grass. Using the Spring Rotation Planner, Summer Wedge and Autumn Planner will allow you to make the management decisions needed to utilise high amounts of the grass grown.
6. Put aside strategic cash and fodder reserves to buffer your business against the ‘rainy days’ of low milk price and poor grass growth.

7. Be aware of latest research findings and advisory messages. Now, more than ever, it is really a case of 'you earn what you learn'. Seek expert advice and opinion to inform your plans. Read the latest reports, ask questions and don't be afraid to try out new ways of doing things. Build a support network to facilitate your ongoing learning and development.

8. Focus on what you can influence. There are a lot of factors that are outside your control e.g. milk price, weather. There are many more factors that are within your control and that you can do something about e.g. milk constituents and quality, grazing infrastructure. Oftentimes we spend too much time worrying about factors outside our control while ignoring those factors we can do something about.

9. Don't be driven by peer pressure. Just because your neighbour, best friend or another dairy farmer is doing something, doesn't mean that it is right for you. Remember that your costs are somebody else's profit. It might be boring not spending money but it is a better place to be in than worrying about meeting loan repayments.

10. Be a wealthy farmer. Wealth is about more than money in the bank. For sure, money in the bank certainly helps and provides the financial security that you desire. However there is more to being a wealthy farmer. Your health is the number one item towards becoming a wealthy farmer. You must also work on relationships, your peace of mind, your career satisfaction and your outlook on life. The key to being a wealthy farmer is to have an acceptable balance across these items. What is the point of having all the money in the bank but poor health or low career satisfaction?

11. Be positive and enjoy dairy farming – remember that we only get one chance at life. It is often harder to be good at something you don't enjoy. If you enjoy dairy farming, you are more likely to achieve what you want from dairy farming.

Table 5: The impact of expected additional profit, interest rate and level of investment on cash available after principal repayments for eight different scenarios

Scenario	1	2	3	4	5	6	7	8
Short Description	Base + imp. eff.	Base + imp. eff. + hi-int	Base + imp. eff. + hi-inv	Base	Base + imp. eff.+ hi-inv + hi-int	Base + hi-int	Base + hi-inv	Base + hi-inv + hi-int
Expected Profit per kg MS, €	2.00	1.80	1.50	1.30	1.20	1.10	0.80	0.50
MS produced per cow, kg	410	410	410	410	410	410	410	410
Expected Additional Income, €/ cow	820	738	615	533	492	451	328	205
Interest Rate, %	4	8	4	4	8	8	4	8
Investment, €/ cow	3,000	3,000	5,000	3,000	5,000	3,000	5,000	5,000
Annual Repayment (15 years), €	270	351	450	270	585	351	450	585
Total Repayments	4,050	5,265	6,750	4,050	8,775	5,265	6,750	8,775
Depreciation	128	128	278	128	278	128	278	278
Interest (average annual amount, €)	70	151	117	70	252	151	117	252
Additional labour, €/cow	300	300	300	300	300	300	300	300
Cash available after principal repayment and labour, €/cow	448	366	260	161	137	79	-27	-150

Assumptions: Stock costs of €1,300 (no depreciation) and other investment costs of €1,700 or €3,700 (7.5% depreciation) respectively. Expected profit reduced for higher interest rates and higher investment options due to increased costs associated with interest payments and depreciation; all other costs assumed to be similar. Additional labour charge of €300 per cow included for all scenarios.

Grass growth on Irish dairy farms from PastureBase Ireland

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Summary

- PastureBase Ireland (PBI) is the first national database of grass DM production in the country
- Mean dry matter (DM) production from a dataset of 40 dairy farms was 11.2 t DM/ha, with on average dry farms producing 11.4 t DM/ha and wet farms producing 10.9 t DM/ha
- There was large variation between farms for grass DM production, with a range from 16 t DM/ha to 8 t DM/ha.
- When analysing the grass growth information it becomes evident that farms that have higher between paddock variation tended to have lower over all farm production.
- Generally there did not appear to a location effect in terms of grass productivity, with high and low grass producing farms observed across the country
- Previous analysis has shown that there is a significant opportunity cost associated with farms not achieving their grass production potential.

Introduction

The potential to produce between 12 and 16 t DM/ha grass dry matter (DM) over a long growing season is a major competitive advantage for Irish dairy farmers. Previous research has shown a strong relationship between total production costs and the grazed grass proportion in the diet of the dairy cow in a number of countries. The average milk production cost was reduced by 1 c/L for a 2.5% increase in grazed grass in the dairy cow diet. The data also demonstrated that a considerable proportion of the dairy cow diet (>50%) must comprise of grazed grass before a significant impact on production cost is realised. In recent years, grazing management strategies have been identified that increase the proportion of grazed grass in the dairy cow diet, which reduces the dependency on indoor feeding in Irish systems. The competitive advantage of grass-based production systems is expected to increase over the next number of years due to higher costs associated with conserved and bought in feed.

There is a requirement to refine and develop grassland technologies while identifying the factors on farm that are reducing grass growth. The development of a national grassland database which incorporates both a front end, where farmers can enter grassland data and a database, to collect all grassland data (commercial and research) would provide valuable strategic data for the entire grassland industry (dairy, beef and sheep enterprises).

With these goals in mind Teagasc launched PastureBase Ireland (PBI) in January 2013, this was built from an in house prototype Grazeplan. The database stores all grassland measurements within a common structure. PBI will allow the quantification of grass growth and DM production (total and seasonal) across different enterprises, grassland management systems, regions and soil types using a common measurement protocol and methodology. The background data such as paddock soil fertility, grass/clover cultivar, aspect, altitude, reseeding history, soil type, drainage characteristics and fertiliser applications are also recorded. PBI will also for the first time link grass growth on farms to reliable Met Eireann weather data.

The objective of this paper is to examine grass growth data from a subset of farms in the PBI database and to identify the variations in grass growth that occurs between farms and the variation that occurs within farm. The paper will also quantify the potential economic loss of under producing paddocks and suggests strategies that farmers could potentially use to increase grass production on farms.

Farm variation in grass growth

Forty dairy farms from the PBI database were selected to provide a representation of grass growth across regions and soil types. Grass production data was calculated from January 1st to October 10th. Average grass production across the 40 farms was 11.2 t DM/ha. There was significant variation between farms, the most productive farms producing up to 8 t DM/ha more than the lowest producing farms. It is likely that an additional 1.5 t DM/ha will be grown on high producing farms by the end of the year. This will further increase the gap between high and low producing farms. Farms producing higher levels of grass can sustain nearly 1.5 -2 livestock units more per hectare than lower producing farms based on the requirement of one livestock unit requiring approximately 4.5 tonnes of DM plus bought in feed.

In general, grass growth on the farms that are growing more grass appears to be primarily driven by highly productive perennial ryegrass swards. There was no link between location and grass growth as high yielding farms were observed throughout the country. However, this data is for one single year the reliability of the data will build over time and as more farmer's data is included. There is likely to be a significant year effect as free draining soils may have suffered unduly due to the moisture deficits that developed on many of these farms in July and in September this year where heavier soils were severely affected the previous year.

Differences in growth between differing soil types

The dataset was classified into either wet or dry farms depending on soil type and drainage characteristics, this information was recorded in PBI when the farms were set up initially. The analysis shows that dry farms grew 11.4 t DM/ha in comparison to wet farms which grew 10.9 t DM/ha (Table 1)

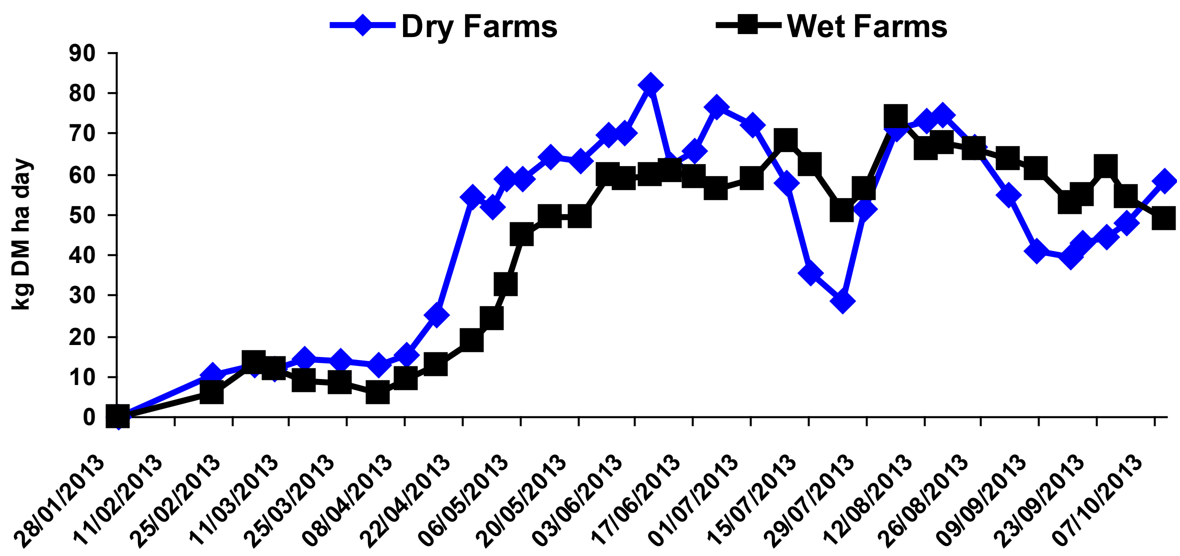
Table 1. Grass DM production on 40 farms from PastureBase, classified into wet and dry farms.

	Mean of all paddocks (t DM/ha)	Std Dev	Minimum (t DM/ha)	Maximum (t DM/ha)	Range (t DM/ha)	CV
All farms	11.2	1.9	6.7	16.2	9.5	17.0
Dry farms	11.4	1.6	8.7	16.2	7.5	15.0
Wet farms	10.9	2.04	6.7	13.9	7.2	19.5

Std Dev – Standard deviation; CV Coefficient of variation.

The distribution of growth for both wet and dry farms is presented in Figure 1. Poor grass growth in March and April are clearly evident on both dry and wet farms. On dry farms higher grass growth rates occurred earlier in the year (May and June). During the prolonged dry periods in July and September growth rates were significantly higher on the wet farms in comparison to the dry farms as moisture deficits negatively affected growth.

Figure 1. Distribution of growth on farms classified as either dry or wet



Dry matter production variation within farms

It is clear that farms producing high levels of grass tended to have less between paddock variation (this is measured by having a low CV – coefficient of variation) in comparison to farms producing lower levels of grass DM. Table 2, shows the mean, standard deviation and CV of 10 individual farms. The desired result is to have high mean DM production and low CV. It is clear that farms 1-4 are achieving reasonable figures. However, Farms 7 – 10 have low mean DM production and have high variation between paddocks. This data suggests highly productive farms have adopted strategies such as regular monitoring of soil fertility, targeting reseeding on low producing paddocks, reducing poaching damage and continuing to maintain high levels of perennial ryegrass within paddocks to maximise production from individual paddocks. While not all farms are grass measuring, it is clear on farms that some paddocks are contributing more grass to the system by having a lot more herd grazing's during the season.

Table 2. Grass production and variation across farms

Farm	Mean DM production (t DM/ ha)	Standard deviation	Coefficient of Variation
1	16.2	1.5	0.09
2	13.9	0.7	0.05
3	13.6	1.8	0.14
4	13.3	2.6	0.19
5	12.3	1.7	0.13
6	9.7	2.3	0.24
7	9.5	3.2	0.34
8	9.3	2.6	0.28
9	9.0	1.9	0.21
10	8.5	3.2	0.37

Paddocks that are performing poorly due to low levels of ryegrass in swards, poor soil fertility or poor drainage offer the greatest potential for increasing grass growth. The reasons for low DM production on paddocks should be identified, and the necessary corrective action taken to solve the grass production issues. It is important that farmers regularly measure grass to identify under performing paddocks. Without reliable on farm grass data, it will be impossible to implement a coherent plan to achieve high levels of grass growth on farm.

Applying economic values to on farm grass dry matter production

Within farm, it is clear that there is a large range in grass DM production, some paddocks vary by up to 37% (Table 2). The financial loss farmers are incurring due to large DM production differences was calculated. This paper investigated the magnitude of DM production difference between two 39ha farms, one farm growing 11 t DM/ha and the other growing 13 t DM/ha. The within farm production differences were very large on the 11 t farm. The difference between the highest producing paddock at lowest producing paddock was 6.7 t DM/ha.

Teagasc Moorepark researchers found that increasing grass utilisation was worth €160 per t DM/ha utilised and explained 0.44% of variation in net profit on commercial dairy farms. If we assume that grass utilisation is 80% on the farm, similar to the levels of utilisation achieved by both farmers presenting at this years dairy conference. The difference in DM production between these two farms is very significant, based on the total difference in DM production of 78t DM between farms the economic difference in performance if the extra grass is utilised at 80% is a difference of €9,984 between the farms. No dairy farmer can continue to sustain such losses.

Table 3. Differences in economic performance between farms growing 11 and 13 t of grass DM/ha

	11 t Farm	€/ha	13 t Farm	€/ha
Top 33% paddocks	12.7	448	14.25	307
Middle 33% paddocks	11.3	269	12.9	139
Bottom 33% of paddocks	9.2		11.85	

Table 4 shows the seasonality of DM production across both farms. It is clear that the 11 t farm has low levels of spring (0.6 t DM/ha) and summer (5.8 t DM/ha) grass production in comparison to the 13 t farm, however, autumn DM production was similar for both farms.

Table 4. Seasonality of DM (t DM/ha) production between base farm and 11 and 13 t DM/ha farms.

	Spring	Summer	Autumn	Total
11 t farm	0.6	5.8	4.7	11.0
13 t Farm	1.5	6.8	4.8	13.0

Within the farm producing 11 t DM/ha, the DM production difference between the top third and bottom third of paddocks was 3.5 t DM/ha, if the extra grass produced is utilised at 80% across this area of the farm (13ha) it is worth €5,824. The difference in grass production between the middle third of paddocks and the bottom third is 2.1 t DM/ha, when this extra grass is utilised this difference is worth €3,497 in favour of the higher producing paddocks. The entire difference between the top and middle third of paddocks compared to the lower third of paddocks is costing the farmer €9,321.

There is 2.4 t DM/ha difference between the top and bottom third paddocks on the farm producing 13 t DM/ha. When the extra grass produced is utilised at an efficiency of 80%, the economic difference is €307/ha, this is costing the farm €3,991. The difference between the middle third of paddocks to the lower third of paddocks in grass utilisation is worth €139/ha, costing the farm €1819. In total, on this farm if the production of the paddocks can be increased to the level of the top third and the extra grass utilised, €5,810 additional profit can be generate.

Farmers need to consider the phase of 'sweating the asset' - that is simply ensuring the farm can grow more grass in the longer term. The key aspect of increasing grass production on farms needs to be addressed by farmers. Continually not acting on the low producing paddocks on the farm will only lead to the farm producing less grass than the farms potential. There is also an opportunity cost of having a land base not performing, this leads to other inefficiencies – swards are less nutrient efficient (not able to utilise fertiliser), requirement for higher supplementary feed inputs, shorter grazing season, less grass allocated per cow, production loss due to underfeeding at grass. Producing less grass DM means that stocking rate cannot be increased effectively. If this issue on farms is not addressed, expanding dairy herds post quota will incur higher costs than presently envisaged and this is not a sustainable situation for the industry. Farmers need to focus on increasing grass production inside the farm gate rather than importing feed into the farm.

Why are paddocks not performing?

There are many factors that limit grass DM production in paddocks, including, low soil fertility, reduced perennial ryegrass content, poor drainage, inadequate grazing management or continued poaching damage. On farms where these issues are not addressed first, reseeding will not solve the problem of poor farm DM production. Areas which may need to be addressed on farms outside of reseeding are outlined in Table 5.

Table 5. On farm factors limiting grass growth and utilisation

Issue	Solution
1. Soil fertility	Test soils and apply P and K Develop soil fertility plan for the farm
2. Low Soil ph	Apply lime as required based on soil test results
3. Poor drainage	Identify the source of the problem and use remedial drainage work where it is viable option
4. Excessive Poaching	Use management strategies such as on/off grazing in wet conditions Improve farm infrastructure such as roadways and paddock layout to improve access to paddocks (Multiple paddock entries) in wet conditions
5. Grazing management	Identify weaknesses in grazing management such as grazing high covers, excessive post grazing residuals. Implement grass budgeting to manage grass supply more efficiently. Participation in discussion groups will increase grazing skills

Reseeding paddocks will change the perennial ryegrass content status in a paddock, however increasing grass production on farms requires management of other issues to achieve maximum efficiency. Both Michael Magan and Dermot O'Connor have clearly outlined their focus on increasing DM production on their farms. While their focuses may be slightly different the end goal is very much the same. The gains from correctly managing all the factors affecting grass growth can be seen on highly productive grass farms where there is little variation in DM production across the farm. The best farms in PBI have coefficients of variation (CV) < 10%, while the lowest producing farms have CV's >30%. The use of discussion groups focussing on grass measurement and utilisation will heighten farmer's awareness of the variation that occurs in grass DM production between and within farms.

Conclusion

The results from the first year of PBI clearly shows that there is significant room to improve grass growth and utilisation at farm level. Where paddock under performance is identified the underlining reasons must be understood and a strategy put in place to address the issues. Only then will a farm be in a position to reach it's grass growth potential. It is clear that there is huge economic loss within and between farms due to variation in DM production, improving grass growth at farm level has the potential to significantly improve farm profitability provided it is followed by sufficiently high levels of grass utilisation.

Using white clover to increase herbage DM production and animal performance

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Summary

- Including white clover in grass swards receiving up to 250 kg N/ha can increase herbage production by over 1 t DM/ha
- Frequent and tight grazing can maintain sward clover content >20% in grazed swards receiving N fertiliser applications of 250 kg N/ha
- Year can have a significant effect on sward white clover content, and sward clover content can increase or decrease from year to year
- Average annual sward clover contents greater than 20% can result in increased milk yield and therefore increased milk solids production per cow

Introduction

White clover (hereafter referred to as clover; *Trifolium repens L.*) is the most important legume in grazed pastures in temperate regions. It grows very well in association with grasses and is tolerant of grazing. The proportion of clover is generally highest in late summer/early autumn and lowest in winter and early spring. Clover has a lower growth rate than perennial ryegrass (*Lolium perenne L.*) at temperatures below 10°C, but its growth rate continues to increase up to 24°C, whereas perennial ryegrass peaks at 15 – 20°C. Growth rates of perennial ryegrass peak in May and June and subsequently decline, while clover growth rate reaches a maximum in July and August, coinciding with the reduction in perennial ryegrass growth meaning that the herbage production potential in the later part of the grazing season can be increased.

Temperate dairy grazing systems based on perennial ryegrass swards are highly profitable. The productivity of systems based on grass only swards relies on high and frequent nitrogen (N) fertiliser application. The EU Nitrate Directive (Council Directive 91/676/EEC) restricts N fertiliser use in grassland; therefore alternative means of increasing herbage production must be investigated. There is now a renewed interest in the inclusion of clover into grass swards due to clover's ability to fix atmospheric N and potentially increase the N supply to the growing sward.

Many studies have found that high N fertiliser application rates can reduce sward clover content. Perennial ryegrass is more efficient at taking up N applied as fertiliser than clover, and as a result perennial ryegrass will grow at a faster rate than clover and the competition between species, particularly for light, results in shading of the clover. Previous research has shown that fertiliser N can be applied to grass clover swards in spring for early spring herbage production and first cut silage, at rates of 50 to 70 kg N/ha to improve herbage production in spring, with minimal effects on annual production of grass clover swards.

Research has also shown the benefit of clover over perennial ryegrass swards for milk production, particularly in the second half of lactation. This increase is due to a combination of both feed quality and intake factors. With the high nutritive value of perennial ryegrass during the spring and early summer along with high growth rates, the benefit from increased clover content during spring and early summer is likely to be relatively small. During the second half of the grazing season, the perennial ryegrass plant enters the reproductive phase of growth resulting in the development of stem, a few leaves and reproductive structures which have relatively low digestibility which in turn results in reduced milk yield. The mid to late stage of lactation for spring calving dairy cows appears to be the best period to target increasing sward clover content, fortunately this period coincides with mid summer and autumn when the clover content of mixed pastures is highest.

Research at Teagasc Solohead has demonstrated the successful inclusion of clover in low stocking rate (<2.2 LU/

ha) milk production systems and found similar milk production per cow on grass clover and fertilised grass only swards. The role of clover in high stocking rate milk production systems in Ireland has not been examined to date and warrants investigation.

The objective of this paper is to outline some of the results from a number of research experiments at Teagasc Moorepark examining the role of white clover inclusion in grass swards for high stocking rate systems (>2.5 LU/ha).

Experiment 1: The effect of grass white clover swards on herbage production and characteristics, herbage intake and milk production of dairy cows (2011 and 2012)

Objective

To compare milk and herbage production from grass only and grass clover swards receiving high N fertiliser application.

Materials and Methods

An experiment was undertaken to investigate the effect of grass only (GO) and grass white clover (GWc) swards rotationally grazed to 4 cm post-grazing sward height on herbage production, sward clover content, and dairy cow milk production. The GO and GWc swards were sown in May 2010. The GO sward was a 50:50 perennial ryegrass mixture of Astonenergy (tetraploid) and Tyrella (diploid) cultivars sown at a rate of 37 kg/ha. The GWc clover sward contained the same grass mixture as the GO sward and a 50:50 white clover mixture of Chieftan (medium leaf) and Crusader (small leaf) sown at a rate of 5 kg/ha. Swards received 250 kg N/ha per year.

Results 2011

Herbage production

The effect of sward type on sward measurements is shown in Table 1. There was an effect of rotation (P<0.05) on all sward measurements. The sward type and rotation interaction (P<0.05) influenced pre-grazing herbage mass. Pre-grazing herbage mass was higher for GO swards in the third rotation, and in the fifth and seventh it was numerically lower than for GWc swards. There was no effect (P>0.1) of sward type on the other sward measurements taken (Table 1). Total herbage production of the sown paddocks was similar for both treatments (13,110 kg DM/ha).

Table 1: Effect of sward type on sward measurements during the experimental period (17 April to 31 October).

	Sward	Rotation/Month 1st Apr	2nd May	3rd Jun	4th Jun	5th Jul	6th Aug	7th Sept	8th Oct	Mean
Pre-grazing herbage mass (>4 cm; kg DM/ha)	GO[1]	1770	1600	2040	2360	1560	1440	2090	1600	1810
	GWc[2]	1660	1630	1720	2190	1780	1480	2240	1580	1780
	SED[3]	153	144	143*	151	144	122	128	133	96
Pre-grazing sward height (cm)	GO	11.3	10.4	10.9	11.1	7.9	7.3	10.3	9.3	9.8
	GWc	11.1	10.7	10.4	10.9	9.0	7.9	11.1	9.6	10.1
	SED	0.68	0.64	0.63	0.69	0.63†	0.55	0.57	0.62	0.39
Post-grazing sward height (cm)	GO	3.9	4.0	4.3	4.6	4.3	4.3	4.2	4.1	4.2
	GWc	4.1	4.0	4.2	4.3	4.1	4.2	4.0	3.9	4.1
	SED	0.21	0.20	0.20	0.22	0.20	0.18	0.18	0.20	0.14
Sward Density (>4 cm; kg DM/cm/ha)	GO	239	225	277	340	433	340	292	190	292
	GWc	236	221	257	365	368	287	267	196	275
	SED	35.3	32.1	29.7	34.2	33.5†	35.9	30.4	34.7	15.1

Average GWc sward clover content was 20%. Clover DM production in the GWc swards averaged 340 kg DM/ha in each grazing rotation. There was an effect of rotation (P<0.05; Figure 1) on both variables as, in general terms, sward clover content and clover production increased as the experiment progressed. The greatest sward clover content was observed in the eighth rotation, in October (26%), and the greatest clover DM yield was measured in the seventh rotation, in September (546 kg DM/ha).

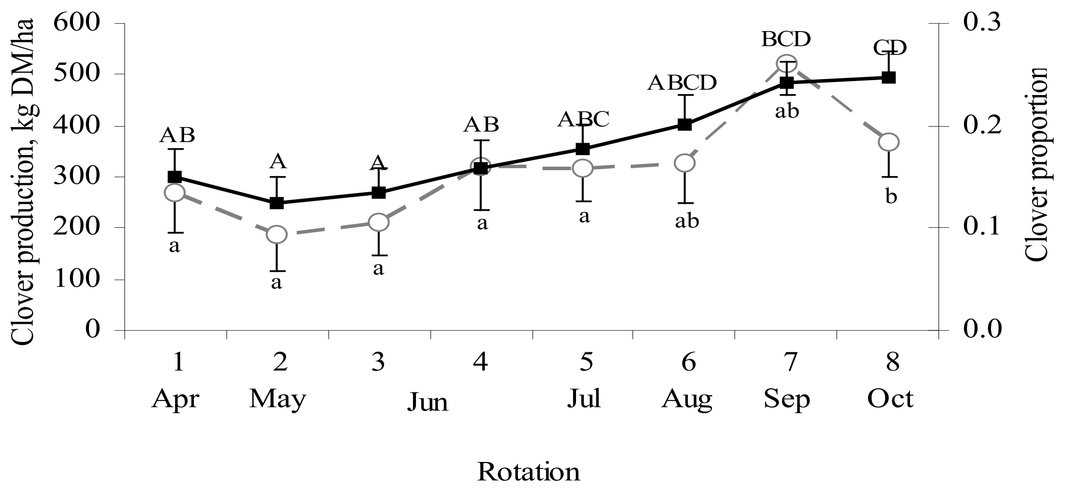


Figure 1: **Sward clover yield (kg DM/ha;) and sward clover content (%;) in the pre grazing herbage mass (>4 cm) of the grass white clover swards during the experimental period (17 April to 31 October). Bars represent SE. Rotations with different lowercase (clover yield) and uppercase (clover content) letters differ (*P*<0.05) among rotations.**

Milk production

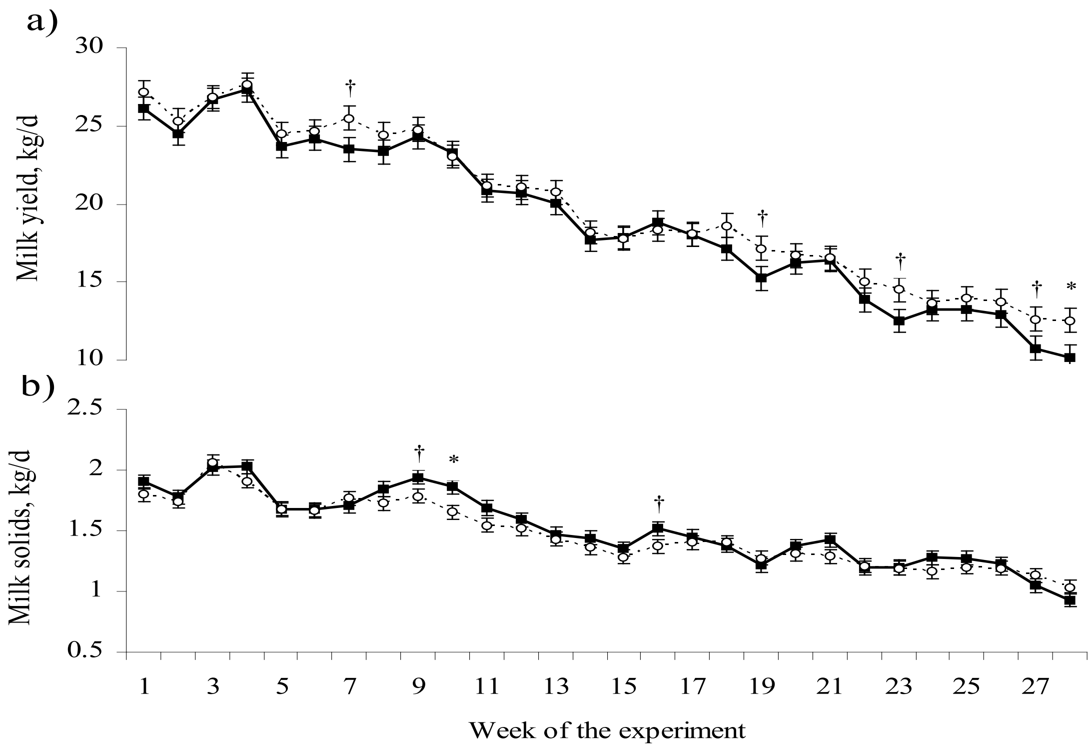
The effect of sward type on milk yield and milk composition of spring-calving dairy cows during the experimental period (17 April to 31 October) is shown in Table 2. There was no effect (*P*>0.05) of sward type on milk or MS yields or the milk composition variables measured, the cumulative milk yield (3,804 ± 124.1 kg/cow) or the cumulative MS yield (293 ± 9.6 kg/cow).

Table 2: Effect of sward type on milk production, milk composition and animal performance of spring-calving dairy cows during the experimental period (17 April to 31 October)

	Sward			Level of significance		
	GO[1]	GWc[2]	SED[3]	Sward	Week	Sward ×Week
Milk yield (kg/cow/day)	19.0	19.8	0.85	NS	***	***
Milk solids yield (kg/cow/day)	1.52	1.47	0.070	NS	***	***
Milk fat (%)	4.31	4.27	0.63	NS	***	***
Milk protein (%)	3.63	3.60	0.60	NS	***	***

[1]GO = Grass only sward; [2]GWc = Grass white clover sward; [3] SED = standard error of the difference; [4] MS = Milk solids; *** = *P*<0.001; NS = not significant.

Figure 2: The effect of sward type (Grass only ( ); Grass white clover ( )) on dairy cow daily (a) milk yield and (b) milk solids yield across the experimental period (17 April to 31 October). Bars represent SE. † = P<0.10; * = P<0.05.



Daily milk yield and daily milk solids yield declined as the year progressed. Across measurement weeks, milk yield was similar for both treatments until the 17th week of the experiment and afterwards it was slightly higher for GWc treatment than for GO treatment (Figure 2). Milk solids yield was slightly higher for cows grazing the GO swards than for cows grazing the GWc swards in the ninth, 10th and 16th weeks (Figure 2). Milk fat content was higher for the GO treatment than for the GWc treatment between the eight and 11th week (P<0.05) of the experiment, but no other clear trends were observed apart from this period.

Results 2012

Herbage production

The GO and the GWc swards had similar pre grazing sward height (10.59 cm) and post grazing sward height (3.98 cm), and pre-grazing herbage mass during the experiment. Total herbage production was 1160 kg DM/ha greater on the GWc sward (14,738 kg DM/ha) compared to the GO sward (13,578 kg DM/ha).

Table 3: Effect of sward type on sward measurements during the experimental period (1 February to 31 October).

	GO[1]	GWc[2]	SEM[3]	Sward	Rotation	Treat × Rot.
Pre-grazing herbage mass (kg DM/ha)	1331	1460	51.84	NS	**	NS
Pre-grazing sward height (cm)	10.4	10.8	0.13	NS	***	**
Post-grazing sward height (cm)	4.0	4.0	0.03	NS	***	NS
Cumulative yield (kg DM/ha)	13578	14738	769	NS	-	-

[1]GO = Grass only sward; [2]GWc = Grass white clover sward; [3]SEM = standard error of the mean; *** = P<0.001; ** = P<0.01; NS = Not significant

Sward white clover content in the GWc sward increased from 8.4% in February to 22.9% in October, peaking in June at 29% (Figure 3).

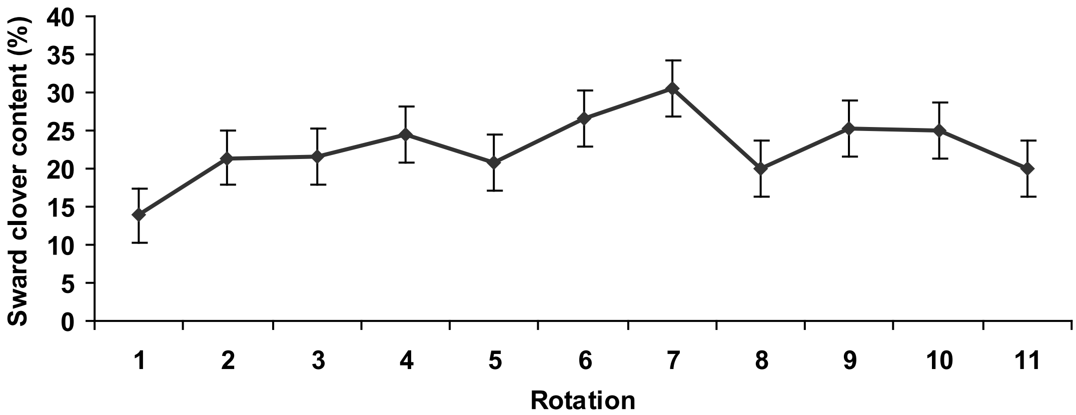


Figure 3: **Sward clover content during rotations 1 to 11 (February to October). Bars represent SE.**

Animal production

Cows grazing the GWc sward had higher cumulative milk yield (*P<0*.01) and milk solids (*P*<0.05) than cows grazing the GO swards (Table 4). There was a significant treatment × week interaction (*P*<0.001). Daily milk production and milk solids production was similar for both swards in the first half of lactation. In the second half of lactation (week 19 onwards) the GWc swards resulted in increased daily milk yield and daily milk solids yield compared to the GO swards (Figure 4). The milk constituents (fat and protein percentage) were similar for each treatment, and so the increased milk solids production was due to increased milk yield rather than increased milk fat and protein.

Table 4: Effect of grass only and grass clover swards on milk yield and milk composition per cow.

	GO[1]	GWc[2]	SEM[3]	Sward	Week	Sward × Week
Milk yield (kg/cow/day)	17.01	18.60	0.45	**	***	***
Milk solids yield (kg/cow/day)	1.41	1.53	0.03	**	***	***
Milk fat (%)	4.90	4.70	0.07	*	***	***
Milk protein (%)	3.63	3.62	0.03	NS	***	***
Cumulative milk yield (1 Feb. – 31 Oct.) (kg/cow)	4788	5048	34.27	**	-	-
Cumulative milk solids yield (1 Feb. – 31 Oct.) (kg/cow)	388	400	1.87	*	-	-

[1]GO = Grass only sward; [2]GWc = Grass white clover sward; [3]SEM = standard error of the mean; *** = P<0.001; ** = P<0.01; * = P<0.05; NS = Not significant

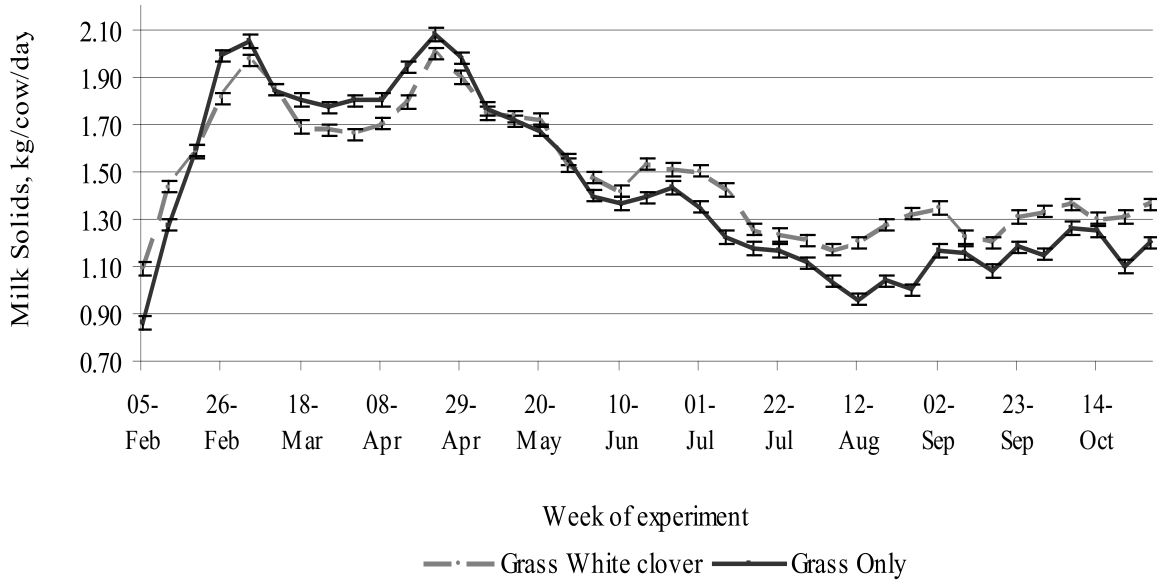


Figure 4. **The effect of sward type (Grass white clover ( ); Grass only ( )) on milk solids across the experimental period (1 February to 31 October). Bars represent SE.**

Experiment 2: Effect of fertiliser N application on herbage production and clover content in frequently grazed grass white clover swards

Objective

To quantify the effect of including white clover in grass swards receiving a range of N fertilizer application rates on herbage production and to quantify the effect of N fertiliser application on sward clover content.

Materials and Methods

A series of grazing plots (8 m × 8 m) were established at the Dairygold Research Farm, Teagasc, Moorepark, Fermoy, Co. Cork in February 2010. Treatments were two swards: grass only (GO) and grass clover (GWc), and five fertiliser N rates: 0, 60, 120, 196, 240 kg N/ha/year. Both swards were sown with a grass mixture (50:50 Dunluce and Tyrella cultivars; 37 kg/ha) and the GWc also included had a 50:50 mixture of Chieftan and Crusader clover cultivars (5 kg/ha). Dairy cows grazed the swards 9 times in 2010 and 10 times per year in 2011 and 2012 and 8 times in 2013. Pre- and post-grazing sward height, herbage removed at each grazing and sward clover content were determined as outlined in Experiment 1. Target post-grazing sward height was 4 cm.

Results

Herbage removed

There was no year × sward type × N rate effect (P>0.1). There was a year × sward type interaction (P<0.01); herbage removed was greatest in 2012 and lowest in 2013 (P<0.001). The GWc swards had higher (P<0.01) herbage production in all years compared to the GO swards, regardless of N application rate (Figure 5).

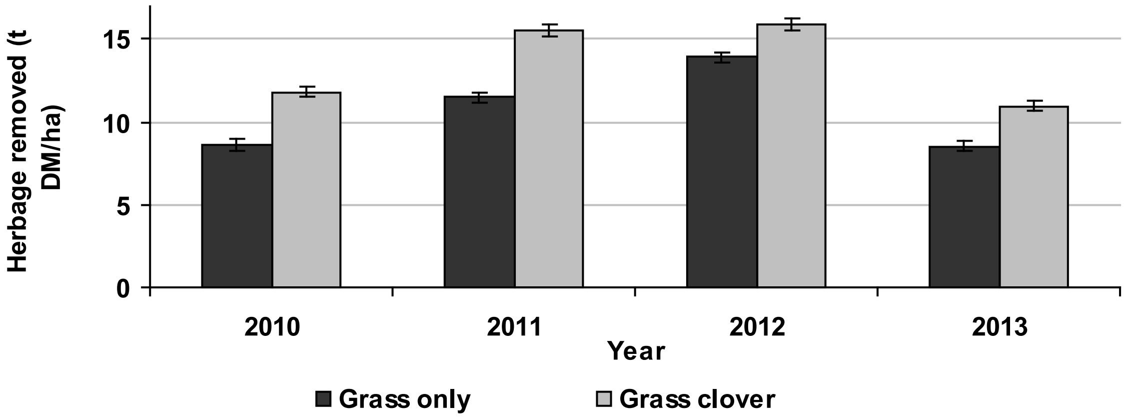


Figure 5: Average annual herbage removed (t DM/ha) from grass only and grass clover swards from 2010 to 2013. Bars represent SE.

Nitrogen fertiliser application had a greater effect on herbage removed by grazing cows from the GO swards than the GWc swards (Figure 6). The herbage removed from the GWc sward receiving 0 kg N/ha was similar to the GO sward receiving 240 kg N/ha.

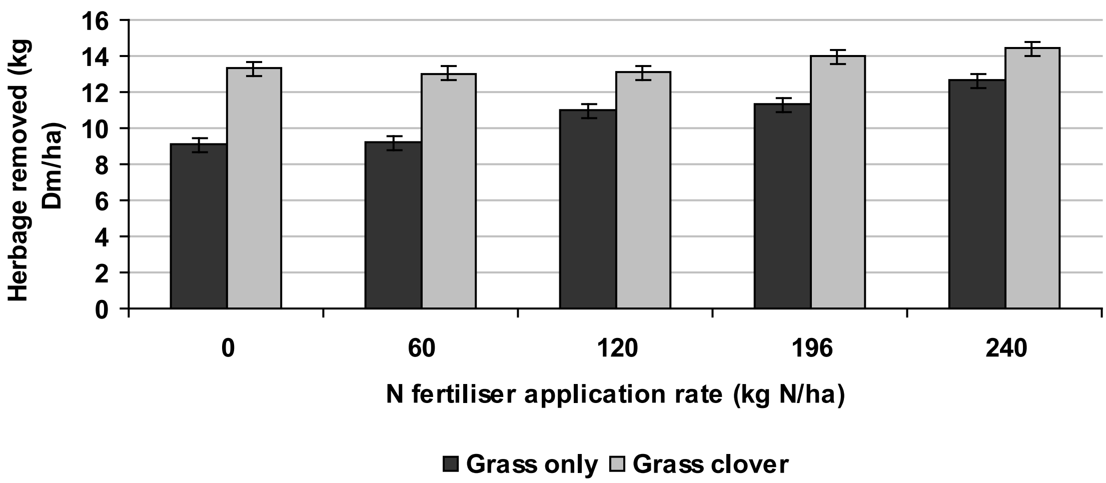


Figure 6: Average annual herbage removed (t DM/ha) from grass only and grass clover swards receiving 0, 60, 120, 196 and 240 kg N/ha from 2010 to 2013. Bars represent SE.

Sward clover content

Year had a significant (P<0.001) effect on sward clover content; it was greatest in 2011 and least in 2012 (Figure 7).

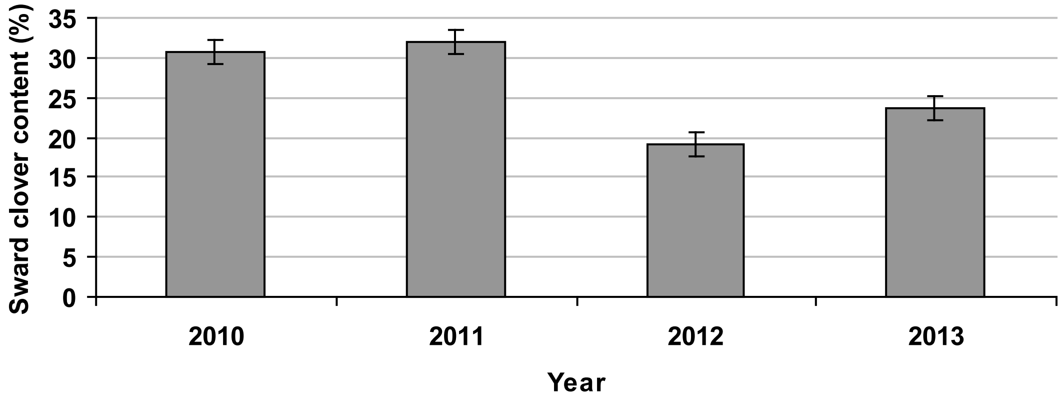


Figure 7: Average annual sward clover content from 2010 to 2013. Bars represent SE.

Sward clover content declined with increasing N fertiliser application rate (Figure 8; P<0.01). Average sward clover content for the four years was greatest for the 0 kg N/ha application rate at 33%, which did not differ significantly from the swards receiving 60 and 120 kg N/ha, and was least for the 240 kg N/ha application rate at 19.5%.

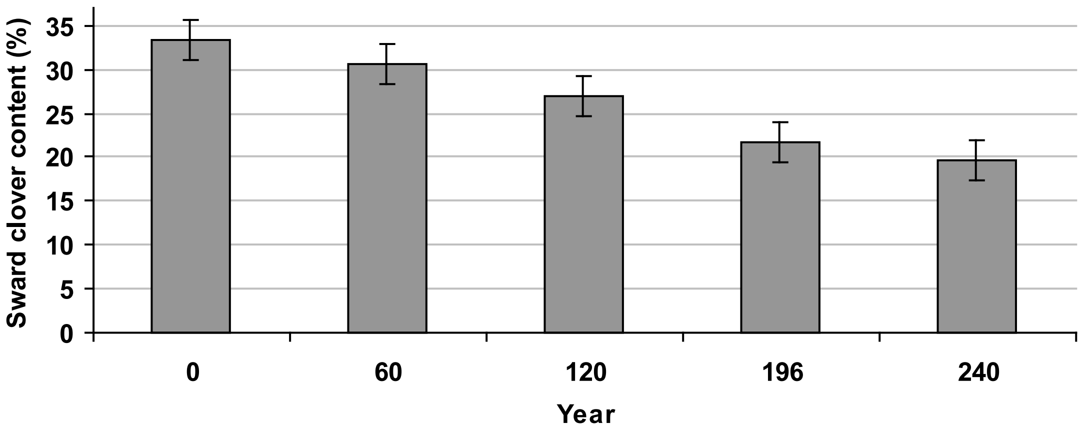


Figure 8: Sward clover content in grass clover swards receiving 0, 60, 120, 196 and 240 kg N/ha from 2010 to 2013. Bars represent SE.

Experiment 3: Herbage production and animal performance on grass white clover swards receiving two N fertiliser application rates compared to grass only high N fertiliser swards

Objective

To compare the herbage production of and the milk production from a grass only sward receiving 250 kg N/ha with grass clover swards receiving 150 or 250 kg N/ha.

Materials and Methods

An experiment was established at Teagasc, Animal and Grassland Research and Innovation Centre, Moorepark, in January 2013. The experiment is a closed systems study with three sward treatments:

- Grass only sward receiving 250 kg N/ha
- Grass white clover sward receiving 250 kg N/ha
- Grass white clover sward receiving 150 kg N/ha

This experiment will be undertaken for three years. Some swards were sown during summer 2012, and others are pre-existing swards. The sown grass only swards comprise of a 50:50 mix of Astonenergy (tertaploid) and Tyrella (diploid) sown at 27 kg/ha, and the sown grass clover swards comprise the same grass species and sowing rate plus a 50:50 mixture of Chieftan and Crusader clover cultivars sown at 5 kg/ha. As this experiment is still on-going, only preliminary statistical analysis has being undertaken.

Results

Herbage production

While this experiment is on-going, herbage production up to the 15 October 2013 was similar between the three treatments (12,500 kg DM/ha).

Average sward clover content was higher on the 150 kg N/ha treatment (average 24%) compared to the 250 kg N/ha treatment (average 21%) (Figure 9). Sward clover content was least in the first rotation (average 6% for both treatments) and greatest in the 7th rotation (45% on the 150 kg N/ha treatment and 30% on the 250 kg N/ha treatment).

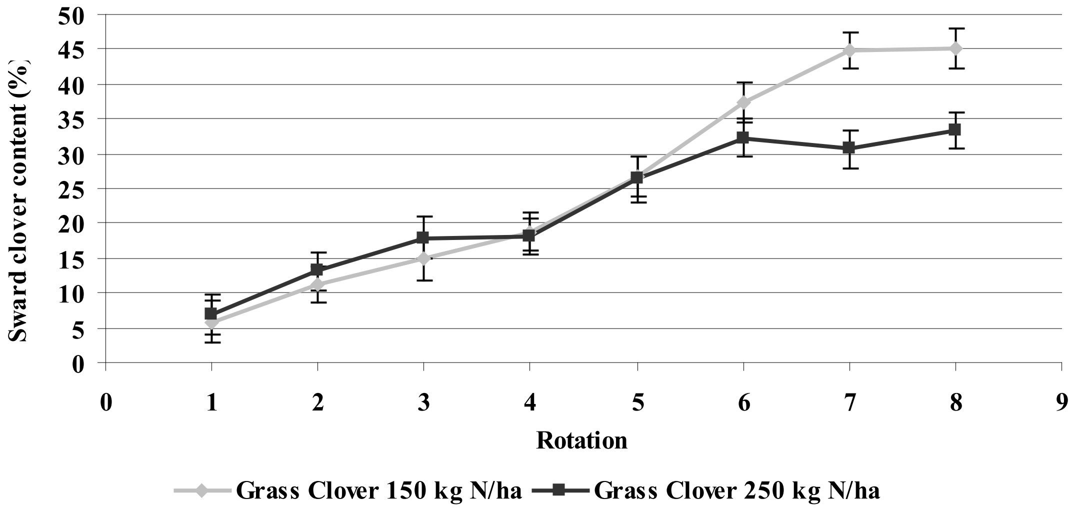


Figure 9: Sward clover content on the grass clover 150 kg N/ha treatment and the grass clover 250 kg N/ha treatment in rotations 1 to 8 in 2013. Bars represent SE.

Milk production

This experiment is on-going, however, average milk yield and milk solids per cow/day, milk composition, and cumulative milk yield and milk solids yield per cow for the period 11 February to 20 October 2013 are shown in Table 5. There was no significant difference between treatments for any of the milk parameters measured.

Table 5: Effect of grass only and grass clover swards on milk yield and milk composition per cow on the grass only 250 kg N/ha treatment, the grass clover 150 kg N/ha and the grass clover 250 kg N/ha.

	Grass clover 150 kg N/ha	Grass clover 250 kg N/ha	Grass only 250 kg N/ha	SEM[1]	P value
Milk yield (kg/cow/day)	22.2	22.8	21.9	0.67	NS
Milk solids yield (kg/cow/day)	1.76	1.77	1.69	0.05	NS
Milk fat (%)	4.41	4.29	4.26	0.122	NS
Milk protein (%)	3.51	3.52	3.51	0.051	NS
Cumulative milk yield (11 Feb. – 20 Oct.) (kg/cow)	5515	5949	5696	269.5	NS
Cumulative milk solids yield (11 Feb. – 20 Oct.) (kg/cow)	453	466	442	20.8	NS

[1]SEM = standard error of the mean; NS = Not significant

Daily milk solids production was similar for the two clover treatments and slightly lower for the grass only 250 kg N/ha treatment for most of the experiment (Figure 10). Significant differences (P<0.05) in milk solids production between treatments occurred at the end of August and in mid-September (Figure 10).

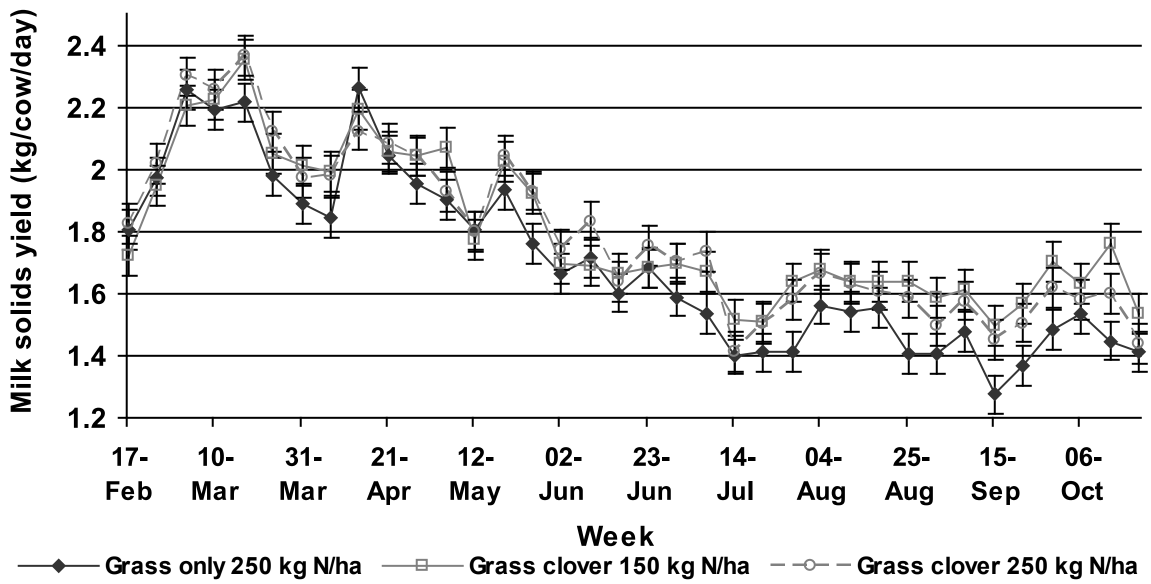


Figure 10: Milk solids yield per cow per day (kg/cow/day) from early February to mid-October 2013 on the grass only 250 kg N/ha treatment, the grass clover 150 kg N/ha and the grass clover 250 kg N/ha.

Discussion

Herbage production and sward clover content

Including clover into grass swards increased herbage production in a number of the experiments reported in this paper; however, differences in production in the first year post sowing were small. The contribution of clover to the sward is small in spring (<10%), and does not begin to increase until April or May, depending mainly on temperature. Sward clover content peaked between August and September and then declined in the autumn and over winter.

Other research indicates that an average annual sward clover content of at least 20% is necessary before an increase in herbage production or animal performance will occur. In the 2011 grazing experiment, sward clover content (13%) was below this threshold and no benefit in terms of herbage production or milk production was observed. In 2012, average sward clover content was 22%, and increased herbage production was observed (+1.2

t DM/ha). The increased herbage production is likely due to the increased availability of N for plant growth as a result of N fixation by clover. The sward clover content observed in the 2012 grazing experiment, at the high N fertiliser application rates in Experiment 2, and at both N application rates in Experiment 3 are similar to that previously observed by Humphreys *et al.* in an experiment with low fertiliser N input (90 kg N/ha/year). In experiment 2, regardless of N fertiliser application rate, including clover in the seed mix increased herbage production. Additionally, when the grass clover swards received no N fertiliser in Experiment 2 and received 150 kg N fertilizer/ha in Experiment 3 herbage production was similar to the grass only swards receiving 240 kg N fertilizer/ha. These similarities show that there is potential to reduce N fertiliser application at farm level without compromising herbage production. Most of the increase in herbage production observed in the grass clover swards occurs after May, when the contribution of clover to herbage mass is increasing.

The frequent and tight grazing (to 4 cm or less post grazing sward height) practiced in all of the experiments reported in this paper appears to have benefited sward clover content. Frequent grazing is more conducive to clover persistence than is infrequent grazing. The more efficient use of fertiliser N by perennial ryegrass than by clover in mixed swards often results in increased and more rapid growth of perennial ryegrass to the detriment of clover, primarily due to shading which prevents light reaching the base of the sward. Clover requires a greater intensity of light at the sward base than perennial ryegrass as light is necessary for stolon production. Therefore, frequent, tight grazing will benefit clover by minimising shading and allowing light to penetrate to the base of the sward. The positive effect of low herbage mass accumulation during the spring on clover content has previously been reported.

Year can have a significant effect on sward clover content, as observed in Experiments 1 and 2. In Experiment 1, 2011 was the second year after reseeding of this sward (sown in May 2010) and sward clover content was low (13%), while 2012 was the third year after reseeding and sward clover content was higher (22%). A previous study with different N application rates found an overall increase in sward clover content from the second to the third year of sward establishment of 8%. In Experiment 2, sward clover content was >30% in year 1 and 2, declined to 19% in year 3 and increased again to 24% in year 4. Long term evaluation of grass clover swards is necessary to determine if sward clover content can be maintained in the fifth and subsequent years.

Animal production

Milk yield and milk solids production were increased in the second year after reseeding on the grass clover swards compared to the grass only swards (2012) but only small differences were observed in the first year after reseeding (2011 and 2013). Milk constituents (fat and protein percentage) were similar for cows grazing grass only and grass clover treatments. On occasion milk fat content was greater for the grass only treatment. Usually clover presence in the sward can decrease milk fat content as clover has a faster rumen passage rate compared to grass. However, similar milk fat content between cows grazing grass only and grass clover swards with clover contents between 22% and 42% have previously been reported. The similar milk protein content values observed for the grass only and grass clover swards in the experiments reported here can be attributed to the fact that well fertilised swards usually have greater crude protein content than that required by dairy cows (15 to 18%). Similar to our results, many grazing studies have found no effect of the sward type on milk protein content.

The variability in the increase in milk solids production in the experiments reported here is likely related to sward clover content. At low annual sward clover content, as occurred in 2011, no benefit in animal production was observed. In 2012 and 2013, when sward clover content was 22% and 30 – 45%, respectively, some increase in milk solids production occurred. It has previously been reported that sward clover content greater than 20% is necessary for increased animal performance. There was a seasonality effect on milk production, regardless of the year, observed in the experiments reported in this paper, with increased milk solids production from the grass clover swards occurring only in the latter part of the grazing season. Other research has shown a benefit of clover over perennial ryegrass swards for milk production, particularly in the second half of lactation, when the increase in milk production is due to a combination of both feed quality and positive intake factors associated with clover (e.g. high digestibility, faster rumen pasture rate compared to perennial ryegrass). With the high nutritive value of perennial ryegrass during the spring and early summer along with high growth rates the benefit from increased clover content during spring and early summer is likely to be relatively small.

Conclusion

The greatest benefit from including white clover in grass swards receiving high N application rate appears to be increased herbage production. Frequent and tight grazing is necessary to optimise sward clover content. Clover can persist in swards receiving 240 kg N/ha/year for at least four years in quantities (>20%) considered desirable for increased herbage production. Inclusion of clover in grass swards has other benefits in terms of animal production. In the mid-season and into the autumn, when grass quality begins to decline, the presence of clover in the sward is likely to increase sward quality, which will have benefits in terms of milk solids production.

Converting grass to milk efficiency

Dermot O'Connor

Shanagolden, Co. Limerick (2012 Young Farmer of the Year)

Summary

- I intend to expand cow numbers from 100 at present to 150 by 2016 which means maintaining 4 t/ha of grazed grass per livestock unit on the milking platform.
- At a stocking rate of 3.0 LU/ha, I need to grow 14 tons of grass Dry Matter/ha and utilise 85% of what is grown. This is 4 t/ha more than I am currently growing.
- Priority will be to improve soil fertility and continue reseeding 15% of the farm annually.

"Measurement is the first step that leads to control and eventually to improvement. If you can't measure something, you can't understand it. If you can't understand it, you can't control it. If you can't control it, you can't improve it."
Dr. H. James Harrington

Introduction

My farm is located in Shanagolden, County Limerick and consists of a 50ha milking block owned and a 20ha leased outside block for silage and rearing replacement heifers. In 2008, I left my construction job to pursue my dream career as a dairy farmer. In that year I entered into a Milk Production Partnership (MPP) with my father Tom, milking 64 cows. From the start we knew the level of production on the farm was not sufficient to provide an adequate income for two families. The MPP offered us the opportunity to expand the herd. Farm costs were the first area to be fine-tuned but the main expansion plan came following time off with a broken leg. During that time I prepared a full financial farm business plan with clear goals to expand cow numbers to 150, supplying up to 60,000kg milk solids through a low cost grass based system. Going forward the clear focus was to monitor grass growth and to quantify exactly how much the farm was capable of growing.

At present I am milking 100 cows. The herd is a typical black and white Holstein Friesian herd and in 2012 my output was 387kg milk solids/cow and my total costs were 22c/litre.

Figure 1: Farm map

Why Grass Measurement?

My father had been operating a low cost grass based system all his farming life and I felt this was also was the most profitable system for me too. With a plan to expand and treble cow numbers (Table 1), I would also need to drastically improve grass growth on the farm, but I had no idea how much grass the farm was growing. As the saying goes: "if you can't measure it, you can't change it".

Table 1: Farm Physical Projections for next 4 years

Year	Cow Numbers	Milking Platform Stocking Rate (LU/ha)	Milk Solids (Kg/ha)	Grass Grown (t DM/ha)
2008	64	1.28	512	N/a
2009	78	1.56	604	8.0
2010	78	1.56	598	8.5
2011	88	1.76	706	9.2
2012	96	1.92	725	9.8
2013	100	2.0	750*	10.9*
2014*	125	2.5	940*	12.0*
2015*	150	3.0	1125*	14.0*

*Projections

In 2009 my local Teagasc Adviser, Joe Kelleher, was looking for a host farm to run a grass budgeting course, so I volunteered as part of my local discussion group to measure grass weekly and host a meeting once a month to discuss progress. With the poor milk price that year I had hoped to feed less concentrates and I felt measuring grass growth was the only way to achieve this. The farm grew 8t DM/ha in that year which was sufficient for 78 cows but not for 150 and further investigation was needed.

Now that I have a routine in place to measure the grass, I can base my management decisions on the data. Using my weekly grass wedge and growth rates I can react earlier to situations of increased growth or poor growth and skip paddocks for silage or increase/decrease meal if needed. By measuring regularly I can anticipate a change in growth two weeks earlier and I am monitoring the whole farm and not just looking at the few paddocks ahead of the cows.

The tools I use to measure grass

I routinely walk the farm every Friday morning throughout the year and in times of doubt I sometimes complete a second walk earlier that week. On average the farm is walked 40 times over the growing season. Each paddock is numbered on the farm map so I can record the grass cover of each paddock in my notebook. These figures are then entered into the PastureBaseIreland programme after the walk. The whole exercise including the walk takes just over an hour to complete. In my opinion this is the most valuable hour's work in the week.

Spring

In the spring I will use the Spring Rotation Planner to manage grass as it gives a daily allocation of area to be grazed. This takes the guesswork out of spring grazing management and ensures I do not end my first rotation before my target date. It also sets up the grazing platform for the year by ensuring that paddocks are grazed to the correct post grazing height (3.5-4cm). It was only when I started measuring grass that I realised we weren't achieving the correct post grazing height and too much grass was left in the paddock. My spring targets in general are simple: graze one third of the farm by March 1st, two thirds by March 17th and finish the first rotation on April 5th. The amount of ground allocated each day rises to correspond with the number of cows calved.

Summer

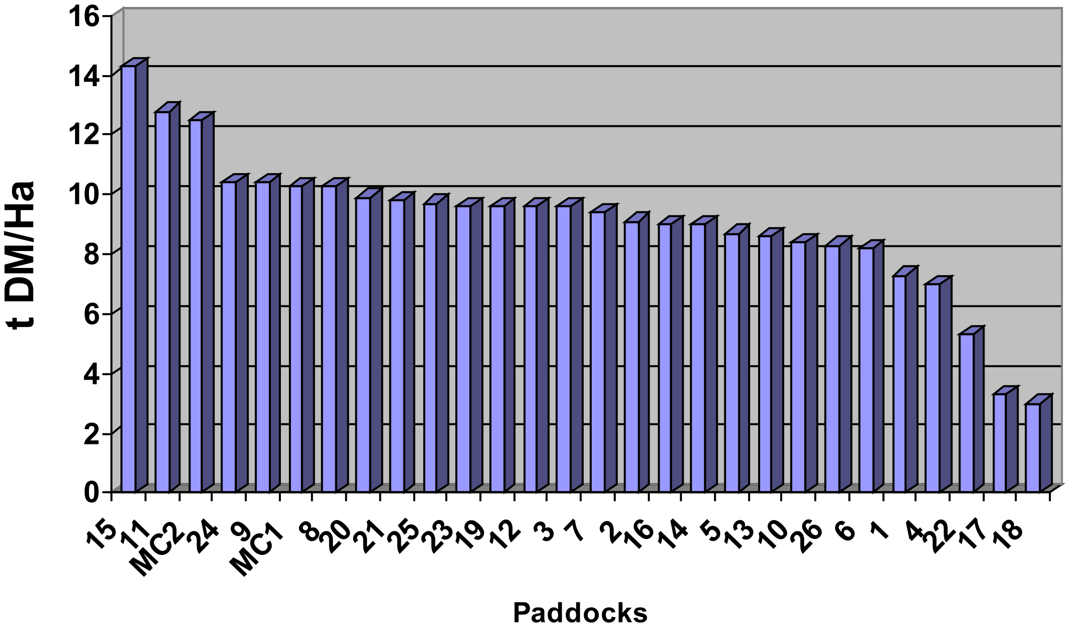
From April 5th onwards I then change to using the grass wedge for interpreting the grass supply on the farm. The key parameter I use throughout the summer is cover/cow (kg DM/cow). I generally aim to have 170/180kg DM/cow available at all times, but it won't worry me if it drops below this in times of good growth. If covers exceed 180kgDM/cow during this period I will remove surplus in the form of baled silage. The main benefit of the wedge is that it allows me to identify a surplus or a deficit of grass appearing ahead of time and enables me to take action immediately to address this and in some cases shorten my rotation from 21 days to 18 days to keep good quality grass ahead of the cows. This year when the effects of drought were becoming clear on the wedge (poor re-growths on paddocks), I introduced baled silage for a fortnight to alleviate the problem before it became a much larger issue.

Autumn

I aim to start building covers from August 1st each year with aim of peaking at 450kg DM/cow in mid September. When the final rotation is about to start in mid October, I will start to use the Autumn planner. Similar to spring time I revert back to working on an area basis rather than cover per cow. The Autumn Planner sets a daily target of ground to be grazed. The primary aim is to get 60% of the milking platform grazed off by early November to have adequate grass for early turnout the following spring. Often this will involve skipping to lighter covers to ensure sufficient ground is closed up in time.

Paddock Performance

Figure 2. Tonnes Dry Matter Grown per paddock up to October 15th 2013



After I have completed my final grass walk, usually in early December, I will analyse the total tonnage of grass grown by each paddock (Figure 2). I plan my reseeding programme based on this information. As can be seen from Figure 2, there is a huge difference between my top performing paddocks and my worst performing paddocks.

My target is to get an average growth rate of 14 t DM/ha across all paddocks and to close the gap between the best and worst paddocks to <10%. I see reseeding and soil fertility as the key to achieving this. In 2013, I anticipate that I will grow 10.9 t DM/ha. This shows a continual improvement from the previous four years. I estimate that I will have utilised 8.9 ton DM/ha of the 10.9 tonnes grown (82%). My aim would be to continue to utilise between 80-85% of the grass produced.

2013 Growth Rates

Like most farmers, 2013 was a mixed year in terms of grass growth, with a very slow start but a very strong finish. The cold spring really highlighted to me the importance of reseeding as these recently reseeded paddocks had much higher growth rates than the old pastures. I got caught for a short spell in July and August with drought but recovered fast when the rainfall returned. Figure 4 compares my 2013 growth rates with the growth rates from farms in the Limerick/Kerry region using Pasture Base Ireland. To the end of October I have fed 380kg of meal/cow.

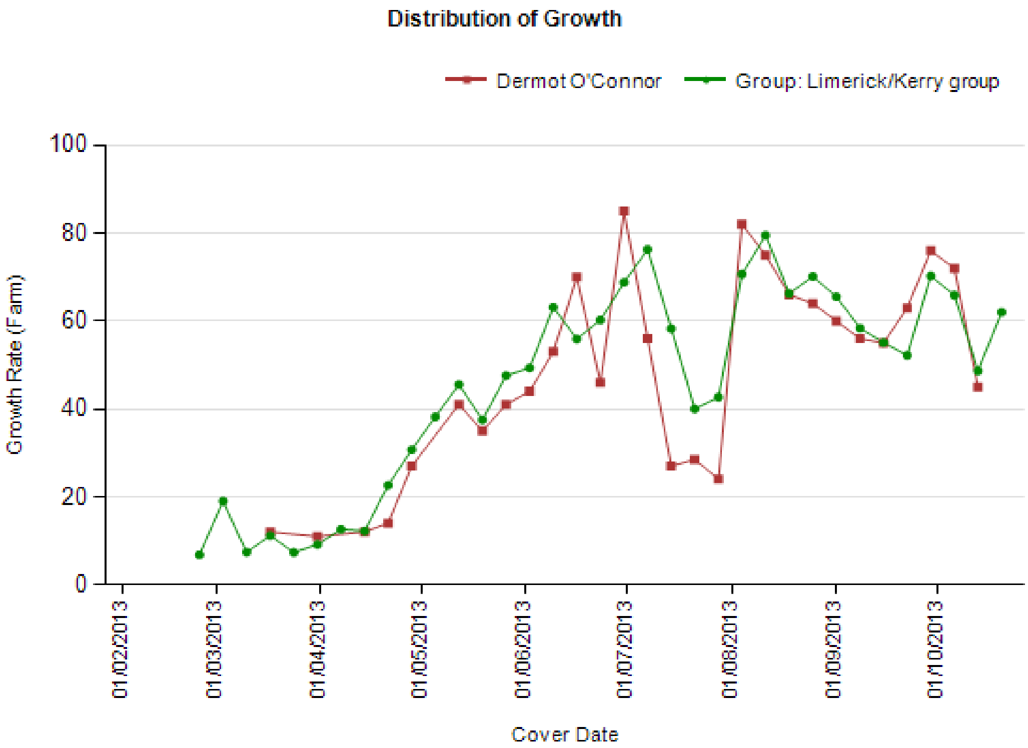


Figure 4: Comparison of farm growth rates to the average growth rates across the Limerick/Kerry region

Fertiliser Plan

I soil sampled the entire farm in late 2011 and 88% of the farm was at index 1 or 2 for either Phosphorus (P) or Potassium (K). I have spent over €6,000 on extra P and K in 2012 and 2013 which has added an extra 1.5 cent/litre to my fertiliser bill but I feel it is starting to show a good return and I am increasing grass growth by 0.7 t DM/ha annually. This Autumn I spread 1 bag/acre of Super Phosphorus (16% P) across all index 1 and 2 soils to boost soil fertility ahead of next year. I have compared the growth rates on my index 1 soils for P versus my index 3 soils for P and I found the difference to be an extra 2 t DM/ha. By focusing on the soil fertility alone, I feel there is an extra 2 t DM /ha to be achieved. This would support 25 extra cows alone on my farm.

Reseeding Plan

I am continuing to reseed 10 – 15% of the farm annually. In 2013 I signed up for the Grass Cultivar on farm evaluation trial which involves sowing monocultures and comparing them against other cultivars within and between farms. This year I have sown Tyrella (diploid) as a monoculture, however, I intend using more Tetraploids going forward, as I see this as being the key to achieving the 14 t DM/ha farm target. Tetraploids should suit my farm, as the land is free draining and ground cover is not as important to me as it would be on heavier soils. Also they are deeper rooted and should be able to tolerate a drought a bit better. In 2014, I am hoping to use a lot of AberGain as it has fantastic annual growth figures, adequate ground cover and should be quite palatable. In the future, I will be targeting higher producing cultivars with high digestibility values.

Looking Forward

At my current stocking rate of 2 LU/ha, growing 8 t DM/ha satisfies my demand for each cow to eat 4 tonnes of grazed grass/year. As my intention is to increase to 150 cows (on the same milking platform) for a stocking rate of 3.0 LU/ha, if I wish to continue to keep 4 tonnes of grass in each cow's diet, then I will need to grow 14 t DM/ha of grass and achieve 85% utilization. If my best paddock can grow this amount of grass (14 tonnes), then I feel all my paddocks are capable of growing this. By improving soil fertility, use of appropriate cultivars when reseeding and continued monitoring and budgeting of grass growth through PastureBaseIreland, I feel this target is well within my grasp.

Collaborative Farming Initiatives

The role for collaborative farming initiatives post-2015

Thomas Curran, Teagasc, Bandon, Co. Cork

Summary:

The major challenge in Irish farming is to mobilise scarce land resources into productive and profitable farm enterprises such as dairy farming. Dairy farming is the stand out enterprise in terms of delivering a profit to the Irish farmer. One of the major constraints to meeting the Harvest 2020 target in terms of expanding Irish dairy farming is gaining access to additional land on the grazing platform and opportunities to convert beef and tillage operations to more profitable dairy operations.

Farm partnerships will play a very significant role in this mobilisation process. They will do this in three ways. They will continue to function where two or more dairy farmers want to combine resources. The new option afforded to partnerships, is where for example, a beef and dairy farmer can combine their resources through a partnership. In this instance, they will provide an avenue for new entrants to dairy farming. As they have always done, farm partnerships will provide a stepping stone to succession in the family farm. This facilitates the gradual movement of the family farm from one generation to the next by allowing the successor to have real responsibility for and involvement in, the day to day running of the farm business at a younger age..

Share farming in Ireland, only exists in a tillage context and in a very limited context in livestock enterprises. A review of share farming models from around the globe and the development of a share farming model to suit Irish conditions is currently underway in Teagasc to facilitate a new avenue into dairy farming for young trained operators. Allied to this, is the already developed template for cow leasing to help reduce the initial financial burden on the new entrants to the industry.

Contract rearing is already operating successfully in many parts of Ireland and has further potential as dairy farmers look to manage labour requirements in the future and increase scale in a no quota environment. It allows the farmer to increase the cow stocking rate on the grazing platform by removing the heifers and replacing them with productive milking cows.

Introduction:

A farm partnership is a business arrangement where two or more farmers combine their respective resources in order to achieve mutual benefits. One could describe a partnership as a symbiotic relationship, where all parties benefit from the arrangement. This is absolutely essential to the ultimate success of the arrangement and is established through the early discussions that take place in forming a partnership. To date, farm partnerships in Ireland have been limited to the dairy sector under the heading Milk Production Partnerships (MPP). Changes made as part of the 2012 national budget have broadened this out to all farm enterprises. In other words, the term Milk Production Partnership will change to "Registered Partnership" and it will be possible to form a farm partnership between any combination of farm enterprises. In Registered Partnerships, the farmers involved will retain their individual status under EU/Government schemes.

The term "Equity Partnerships" is frequently misused and often causes confusion. Essentially all farm partnerships are equity partnerships, where both parties contribute equity to the arrangement in the form of assets which are given an economic value or equity in the form of capital.

There are essentially two types of Registered Partnership: A family partnership between a parent (or both parents) and a son or daughter (or multiple sons or daughters). A non family partnership is where two or more farmers come together to farm as one entity.

Benefits of Farm Partnerships:

A study by Áine Maken Walsh on milk production partnerships in Ireland has shown that there are many benefits to forming such arrangements between farmers. The benefits can be divided into the following: economic benefits, social benefits and occupational heath and well-being benefits.

Economic Benefits:

Economic benefits are varied but all such benefits impact positively on the economic viability of the parties involved. Many family partnerships were created to gain access to milk quota. In certain instances, this allowed substantial expansion to create a second income from the farm business. However, when milk quota is abolished in 2015, this will no longer be an economic incentive. What is often understated in this situation is that these family partnerships also allow the younger successor to operate on a very strong and official footing within the partnership. While the milk quota incentive will no longer be there in the future, the pathway to succession will continue to function and provide access for a new generation of Irish dairy farmers. Increased stock relief (50% after first four years) and a doubling of the limits for the dairy investment scheme are two financial incentives that remain.

Partnerships are likely to continue to play a significant role in combining farm family resources to create larger more efficient enterprises. To the dairy farmer there is the potential benefit of increase scale and options to expand. To the non-dairy farmer, there is the option to get involved with an experienced dairy farmer and also to get involved in the most profitable farm enterprise. Farmers who enter partnership arrangements bring with them varying skill sets that when merged together, can become a greater asset to the farm business. They can also introduce news ways of doing things and business strategies that lead to more profitable farm enterprises. The availability of good quality farm labour on expanding dairy farms is a much talked about issue. Where two farmers go into partnership, they can overcome this problem as there will now be two highly skilled and highly motivated people running one farm as opposed to two separate operations.

Social Benefits:

Lifestyle is a growing concern among many farmers. Having time to pursue other interests and attend family events. Entering into a partnership can lead to many social benefits such as taking time off for weekends away, family events and a much needed family holiday. On a day to day basis a partnership can lead to earlier finishing times to facilitate off farm interests and hobbies. From a family perspective, it allows for time to do school runs and attend events such as sports events, with the family in the evenings. This is mainly due to the fact that there is at least a second partner to keep an eye on the farm while these events go on. This role is rotated and discussed within the partnership to allow both parties to benefit in this way.

Health and Well-Being:

Dairy farming is time consuming and requires a high level of commitment to be successful. Many farmers today find themselves working alone for long periods of time on a daily and weekly basis. Partnerships can provide a real solution to this where a farmer enters into a partnership with another farmer and there is at least one other person to work with on a daily basis. It does not mean that both parties have to work along side each other on a full-time basis but with the division of farm tasks, it becomes possible to take a bit of time off during the day to spend with the family or attend a discussion group meeting.

Other Collaborative Initiatives:

There is a broad agreement across the farming sector and certainly within Teagasc that there is a need to make available, as many avenues to a career in farming as is possible. Due to high rent land prices and a very low level of land sales, it is difficult to create opportunities to get into dairy farming. Initiatives such as the new entrant scheme have facilitated a number of new entrants to dairy farming. However, many of the successful applicants already had access to land, the basic requirement to start a new dairy enterprise.

Share Farming:

Share farming is an agreement between two parties to farm on the same area of land. As a concept, it has been operating very successfully in Ireland, mainly in the tillage sector and it is growing in popularity as a way of overcoming the problems associated with the conacre system.

From a dairy perspective, it has great potential to offer a viable avenue of entry to the industry for enthusiastic, trained individuals. The current age group of dairy farmers and in some cases a lack of successors means that a share farming model may have a significant impact in Ireland. What is essential to its success in a dairy context is the ability of the young person to enter the arrangement at a low level, but have the opportunity to build up equity to progress to a higher level or even farm ownership. The major stumbling block to date has been the milk quota regulations and the scale of most dairy farms in Ireland where the potential to develop two incomes from the same farm was not there.

With the abolition of quotas in March 2015, it is essential that we have a working share farming model for dairy farming in Ireland. We in Teagasc are currently reviewing share farming models as they exist in other parts of the world and are working on a template for share farming in a dairy context for Ireland. It is hoped to have this available in 2014.

Cow Leasing:

Given that young entrants to dairying may not have large resources in the form of cash or stock or the security to obtain finance, Teagasc have developed a template for cow leasing. It is currently awaiting approval from the Revenue Commissioners. The option of being able to lease cows as opposed to buying cows could be of major benefit to the young share farmers or new entrants in general where resources are very limited.

Contract Rearing:

Contract rearing occurs where a dairy farmer enters into an arrangement with a rearer to take in the replacement animals and rear them to an agreed stage. The stage that the animals are reared to and the point at which they go to the rearer are set out by the two parties at the outset. Many dairy farmers are looking at the option of contract rearing to rear their replacement animals. Indeed, there are many arrangements successfully in place at this stage. Teagasc have produced template agreements, where the guidelines can be set out by both parties. The benefits to the dairy farmer can include reduced labour and land rental requirement as well as the option to substitute the replacement stock for productive milking cows on the grazing platform. To the rearer, the benefits include a regular income source when compared with most beef enterprises and an increased profit level.

The guidelines can be set out by both parties but they will often be based around target weights at key stages of development and may even include a weight bonus system. The costs of rearing to the dairy farmer and the income level for the rearer will often depend on which party incurs the various costs to get a replacement animal from birth to calving down.

Is profit really the bottom line?

Kevin Connolly

Teagasc, Coolshannagh, Monaghan, Co. Monaghan

Summary

- After profit is made you still have decisions to make on how it is best distributed
- You can exert better control on the distribution of profit by regular monitoring of discretionary or free cash.

Introduction

I often hear farmers comment on the fact that while they see a figure labelled profit on their accounts or Teagasc Profit Monitor and it looks fairly healthy, they don't seem to have the money to match the profit.

Farm businesses are run to make profit. Generally the bigger the profit the better the farm has performed. Farms need to be profitable to continue to stay in business and to ensure that the business owners get a reward for the time, effort and money they have invested.

Here is an example of how profit is calculated

Sales		900
Plus increase in livestock inventory		100
		1000
Minus		
Cash Costs	600	
Interest	100	
Depreciation	100	
		800
= Profit		**200**

The manager's job does not finish at the bottom line

The profit figure arrived at after a full year of business is often called "the bottom line". But is this really the bottom? Are there any further decisions for the owner to make once the profit is made?

While the farm is generating profit month by month, that profit is also being funnelled in different directions to cover the following demands:

- Paying tax
- Repaying farm debt
- Drawings/ living expenses for the farm owner
- Investing in new assets

Paying Tax – for some people, being profitable can be a double-edged sword in that higher profits mean higher taxes. Taxes are just another expense - albeit not a tax-deductible one. Taxes should be planned for, controlled (legally!) and paid without putting pressure on business cash flow. It is good practice to create a bank standing order from the business account to a separate account to have a tax payment fund in place so when tax return time comes around the funds are there to pay it.

Repaying farm debt – paying back the original amount borrowed – also called the principal. This is different from interest, which is the cost of borrowing, and is already deducted in the calculation of profit. Both the principal and interest are combined in the loan repayment that is made at regular intervals. While the interest is deducted in the calculation of farm profit the principal is not and so part of the profit must be targeted at repaying it.

Drawings/ living expenses – this is cash required by the farm owner to meet personal commitments. These commitments include family living needs, family savings and potentially saving for retirement using pensions. Many owners also operate a bank standing order for a fixed amount from the business account to a personal bank account to cover weekly living expenses with the flexibility to withdraw extra when required.

Business (re)investment – investment here refers to new investment and not to replacing an asset which was already in use in the business. Any replacement of existing assets is not included as it is already accounted for in the calculation of profit through the depreciation charge. Examples of the type of new investment could be cash invested in new machinery, buildings/ facilities or land any of which could also be part financed by new borrowings. It also covers cash that is left in the business bank account, unspent at the moment but which will be spent on business assets in the future. For a farm in expansion mode this investment can also be seen in the build-up of breeding stock numbers on the farm which are factored in to the calculation of profit through the inventory change figure.

Following on from our previous example, next we will show how the profit made was allocated on this farm:

= Profit		**200**
Allocated to		
Tax Paid	10	
Debt Principal Paid	30	
New investment	110	
Drawings	50	**200**
		0

So we can see that during the year the full amount of the profit has been completely used up. This allocation of profit happens every year for every business and it explains why you can't just pocket the profit at the end of the year and head for the hills. It also backs up the well known fact that "Profit is not Cash".

In allocating the profit to these areas there are decisions to be made as there is only so much of this profit to go around; too much earmarked for one area means less for the others. Of these areas there are certain cast-iron commitments which must be met – paying tax and paying back money owed are two definite items. After that there is some discretion in the allocation of "what's left" or the discretionary / free cash.

Calculating Discretionary or Free Cash

Having a clear idea of the Discretionary Cash (also called Free Cash Flow) would give a better indicator of how much is actually left after we have spent what is required to run the business and meet necessary obligations. This is a real cash figure that exists and that the business manager can decide to spend as they wish. By revisiting our example and showing the calculation of this cash measure alongside our profit calculation we can highlight the differences between the two.

Profit Calculation

Sales		900
Plus increase in livestock inventory		100
		1000
Minus		
Cash Costs	600	
Interest	100	
Depreciation	100	
		800
= Profit		**200**
Allocated to		
Tax Paid	10	
Debt Principal Paid	30	
New investment	110	
Drawings	50	**200**
		0

Discretionary / Free Cash Calculation

Sales			900
Minus			
Cash Costs	600		
Interest	100		
		700	
Tax	10		
Debt Principal Paid	30		
		40	740
Discretionary or Free Cash			**160**

To arrive at the cash amount within your control then you must exclude the non-cash items (livestock inventory increase and depreciation) that were used in the calculation of profit. You deduct the amount needed to cover tax and debt repayment and "what's left" is what you have freedom to distribute. You will notice that the figure for "New Investment" is excluded in the calculation of discretionary cash even though this appears to have already been mostly allocated in the build-up of livestock inventory. The payment of drawings is also assumed to be within your control as to the level of payment.

Using this information to make decisions

So in this example the discretionary cash amount of €160 can be spent whatever way the owner pleases. Some of the possibilities for this include:

- Withdraw it from the business as either necessary or additional drawings – there will be a normal drawing amount that the owner feels is necessary. If the free cash amount is large enough then the drawings amount could be increased and the owner can treat himself and his family in the sure knowledge that the business cash flow will not be detrimentally affected.

- Invest it in the farm business – this could be on building up stock numbers or on fully or part funding the purchase or building of new business assets such as land, machinery or facilities. Alternatively the decision could be made to invest this in a deposit account i.e. bank the funds in the expectation of an investment in the future or keep it as a 'rainy day' fund in expectation of the next challenging year.

- Make accelerated debt repayments – for some reducing debt to a manageable level is seen as a priority and the option taken may be to divert a share of the free cash to paying down business debt quicker. Reducing debt has the effect of reducing the overall interest bill and by moving the debt:asset ratio in a favourable direction it can set the business up for future borrowing for investment. Reducing the debt burden and thereby increasing the owner's share of the business can also give the owner a sense of satisfaction as well as peace of mind.

The only fool proof way of getting a handle on this free cash amount is by monitoring cash flow and combining this with a forward cash flow budget. These words may strike fear into the hearts of those that feel they do enough office work as it is but it is the only way of really taking full control of farm financial decision-making. Many Teagasc clients currently use the Teagasc Cost Control Planner cash tracking tool for the purpose of monitoring and budgeting cash flow. The feedback from farmer users of this tool is that using it to track cash helps them keep tabs on business spending and makes it easier to plan forward for spending during the year without causing a cash flow crisis.

Conclusion

While Net Profit will always be an important measure to track business performance, monitoring Discretionary Cash will give an even better indication that the business is moving in the right direction. Quantifying the available discretionary cash and making an informed decision on which of the above three options to spend it should give the farm business owner confidence that spending and investment decisions have a greater chance of being the correct ones. This feeling of "control right to the finish" in the business is the missing link for some business owners in helping them to be confident in their ability to manage for maximum return.

Steps to improve labour efficiency on dairy farms[5]

Trevor Dunwoody[1] and Tom O'Connor[2]

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Summary

- Herd size will increase post 2015 and labour will become a limiting production factor on many farms.
- National Farm Survey data for 2012 shows that a labour unit (1,800 hours work) on dairy farms is managing 45 livestock units.
- This year over 30 discussion groups examined labour input on their farms. On average one labour unit was managing 54 livestock units on these farms, with the most efficient 10% managing 90 livestock units
- The most efficient farms were milking more cows per hour, had labour efficient systems for calving and calf rearing and shorter breeding seasons
- Use of contractors was higher for labour efficient farms, including fertiliser spreading and heifer rearing

Introduction

Between 2001 and 2010, the number of active dairy suppliers fell from 27,814 to 18,294. There was a parallel rise in average quota and herd size during the same period and the percentage of herds with greater than 450,000 litres of milk quota increased from 4% to 13%. Average herd size is expected to increase further in the next decade (Teagasc Roadmaps 2013). While quota was the main limiting production factor in the previous years, land and labour efficiency that will become the restricting factors in the future.

The Food Harvest 2020 report has set the ambitious target of increasing milk output by 50% on 2008 – 2009 levels. Some farms will increase production by increasing labour efficiency with current labour available, others farms will need to recruit and manage additional labour on the farm. This paper will look at ways to increase labour efficiency on farm with current labour resources.

Background: Moorepark Survey 2000 - 2002

This survey was conducted between 2000 and 2002. On average 41 hours of work was required per livestock unit (LU) on this study. This equates to approximately 44 LU / labour unit. One labour unit is classified as 1,800 hours work in the year. It established that 10.1 hours per day were worked on dairy farms selected for that study.

This project allowed further research to focus on systems and components that increase labour efficiency on dairy farms. Further projects on calf rearing, once a day (OAD) milking, low labour wintering facilities, cow type / genetics and grass utilisation were initiated after this labour study.

Since this on-farm study there have been changes at farm level with a total of €7.67 billion invested on Irish farms between 2001 and 2009 (NFS).

National Farm Survey

Each year participants in the National farm Survey are asked to quantify the number of hours worked on their farm for themselves, their family and employees. This is weighted up to give a national figure. For 2012 the average hours worked per LU was 44 hours, which is equivalent to 41 cows per labour unit. This NFS for 2012 represents an average herd size of 67 cows. Total hours worked per day was 10.0 (based on 365 days), of which the farmer worked 6.7, family 2.2 and employees 1.1.

5 The authors wish to acknowledge the assistance of Pat Clarke, Dairy Specialist, Athenry, Padraig O'Connor, Teagasc Grange and our farmer clients in completing this paper.

Discussion Group Analysis 2012/13

In the last two years discussion groups have started to examine labour efficiency in their groups. A questionnaire is filled out and a group report produced for use at group meetings. To date a total of 30 groups have completed the analysis. The following were two of the key measures to measure labour efficiency on farm:

a) Livestock units per labour unit: The average livestock units per labour unit were 54, with the most efficient farms at 90. These efficient farms were working 20 hours per livestock unit.

b) Total labour per day: Total hours worked per day was 13.6 hours, with the farmer accounting for 9.1, family 2.7 and employed 1.9. The most efficient farmers were working 8.1 hours per day which is equivalent to 57 hours per week.

All farmers were asked to identify an acceptable number of hours to work per week. The average response was 59 hours. The actual hours worked per week was calculated at 67 hours per week. This difference is the main starting point for any discussion on labour efficiency on a dairy farm.

Lessons from the most labour efficient farms

The following are some of our observations on the most labour efficient farms

Milking Process

The most efficient farmers milk 120 cows per hour. They also have a shorter milking interval (9:18 hours: mins) between morning and evening milking. Evening milking is rarely delayed. A higher proportion of these clients have a backing gate and drafting facility which enables the milker to remain in the pit for the duration of the milking process. The start of evening milking is 45 minutes earlier on these farms and this is a key factor in determining the finish time of the working day.

Calving

Our most efficient clients had an adequate number (at least one place per 10 cows) of calving pens. Calving pens are cleaned mechanically and some feed silage at night to reduce night time calving. Attention to achieving correct cow condition at calving and use of easy calving bulls is practiced which ease calving workload on these farms

Calf rearing

These efficient farms have group calf feeding facilities and a high proportion practise once a day calf feeding. Calves also tend to go to grass earlier.

Grassland

Our most efficient clients operate a long grazing season, with cows out in spring after calving and grazing continued late into autumn. They operate three grazings per paddock without strip wire during the main grazing season. On these farms paddocks were topped either once or never. A good roadway surface is key to achieving good cow flow to and from the parlour and minimizing incidences of lameness.

Breeding

A shorter breeding season results in compact calving, shorter calf rearing season and gives a break between calving and breeding. The efficient farms have more compact calving than the average, they all use heat detection aids and replacement heifers are synchronised. Drafting facilities are available.

Contracting

Contractors are replacing labour on farms especially for slurry and fertiliser during the busy spring period. These farmers also use contractors for pit and bale silage. We also have clients who are contract rearing heifers. In some situations farmers have reverted to an AI technician for breeding.

Work organisation

The most efficient farms have a separate farm office and have a farm map clearly identifying all paddocks. Many of these farmers also complete office work in the morning, rather than at night. Herd health screening and working to a herd health plan are important to these farmers. Appropriate handling facilities, especially on all out farms, are important for organisation of daily work.

Output

The efficient farms were achieving 33,500 kg of milk solids (MS) output per labour unit. They were targeting 100 cows with each producing 450 kg MS which is 45,000 kg MS per labour unit

Table 1 outlines the main difference between the average and most labour efficient farms.

Table 1: Average and most labour efficient farms from 30 discussion groups

	Average	Most efficient farms
Livestock units per labour unit	54	90
Hours of work per Livestock unit	33	20
Farmer - hours worked/week	65.	57
Farmer - acceptable working week	59	55
Finish time in the evenings	7.07 pm	6.05 pm
Drafting facilities present	53%	73%
Backing gate present	30%	51%
Milking interval	10:04	9:18
Delayed evening milking	86%	59%
Start evening milking	5:25 pm	4:39 pm
Date calves to grass	Apr 7th	Mar 30th
OAD feeding	24%	49%
Calving pens mechanically cleaned	72%	92%
Slurry contractor	40%	53%
Fertilizer contractor	9%	27%
Heifer contractor	4%	17%
Heifer synchronised	30%	46%
Paddocks topped once/none	53%	78%
Three grazings/paddock	36%	51%
Output (kg milk solids per Labour unit)	21,200kg	33,500kg

Discussion group members were also asked what technologies/changes did the implement in the last five years to improve labour efficiency on their arms. The following were answered most frequently: grassland (37%), milking parlour (36%), contracting (25%), calf rearing (25%), calving (19%), housing (19%) machinery (19%) less enterprises (18%), winter management (18%), drafting (8%), breeding (7%) and employing labour (4%).

Conclusion

Herd size will increase post 2015 and labour will become a limiting factor for many dairy farms. It is import that farming systems are labour efficient and streamlined before additional labour is employed on farm. Currently we see farms which have improved labour efficiency without additional labour. These farmers have efficient systems in place for the milking process, calving and calf rearing, grassland management and breeding. These farms also make efficient use of contractors to complete work particularly during the busy spring period.

Identifying and Managing Risks

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Introduction

Agriculture and the dairy sector in particular, have entered a phase of considerable change. Traditional EU policy supports are now less prevalent due to recent CAP reform and the most significant policy in the dairy sector, the milk quota, is to be removed in 2015. One of the consequences of recent and impending shifts in the policy focus is an increased exposure to risk at the farm level. Risk is an inherent part of agricultural production and it comes in many forms. In the past the EU have employed a suite of policy instruments with the aim of isolating internal EU dairy prices from the greater volatility associated with world prices. Intervention purchasing placed a floor on prices while other measures such as production quotas, export refunds, import tariffs and subsidised consumption measures were used to ensure higher and much less volatile prices than those pertaining in world markets. In light of these (policy) changes in particular, this paper examines the role of risk at farm level in the dairy sector in Ireland. The main objectives of the paper are (i) to identify the main sources of risk at dairy farm level and (ii) identify methods for coping with/or reducing risk at the farm level.

The next section of the paper will proceed with a background section which draws on aggregate data (both inputs and outputs) to highlight how important risk is for Irish dairy farms. Results of research findings focusing on the identification of the important sources of risk at the farm level are then outlined, followed with a section on how to manage risks at the farm level and finally some conclusions are identified.

Background

There are many sources of risk at the farm level. This section outlines the historic variation in a number of key variables that affect margin on dairy farms.

Milk Price

Much of the focus on the risk associated with agriculture in the past number of years has been on output price. Price variation can be considered desirable in terms of providing price signals that reflect changing market conditions, which lead to changes in resource allocations. Nevertheless, the principles of economics suggest a set of mostly negative consequences of extreme price volatility for producers. For example, very low prices can threaten the solvency of the farm unit, and lead to damage to productive capacity. Very high prices, however, can also be problematic, in that they can result in product substitution on the consumption side, (consumers forego a product whose price has risen in favour of a cheaper alternative) which can, later on, be difficult or even impossible to reverse. The exceptional price volatility in several agricultural commodity markets in recent years is creating problems for processors, farmers and other food supply chain participants.

Figure 1 below illustrates the historic variation in monthly farm level milk price in Ireland and on the world market (as illustrated by NZ milk price) from 2001 to 2013. Using New Zealand milk prices as a proxy for world milk prices, there has been a convergence in milk prices in recent years, as can be observed in Figure 1.

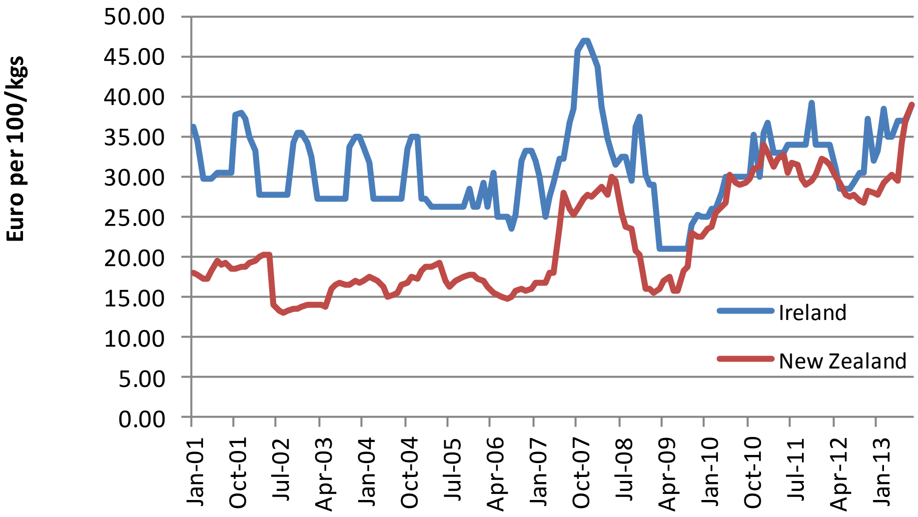

Figure 1: Monthly Farm level Milk prices: Ireland and NZ (2001-2013). Source: Milk Development Council, UK

Figure 1 not only provides an indication of the level of prices over the recent past, but also provides information on the volatility in milk prices over the same time period. Prior to 2007 there was virtually no evidence of extreme price volatility for farm gate milk price in Ireland. However, post-2007 it is very obvious that volatility has become a major feature of the market.

Input Prices

There has also been a pronounced volatility in agricultural input prices in recent years which has had an adverse impact on producers. Figure 2 shows the extent of the variability of monthly feed and fertiliser prices in Ireland from 2001 to 2013.

Animal feed and fertiliser are the main inputs which affect the cost of milk production. The impact which the price of these inputs will have on the cost of production will depend not alone on the extent of the price change, but also on the extent to which they are required in the production system. While there has been a general upwards trend in these input prices over the period shown, the increase in prices has increased significantly since 2005 and there was also a pronounced spike in prices in 2008.

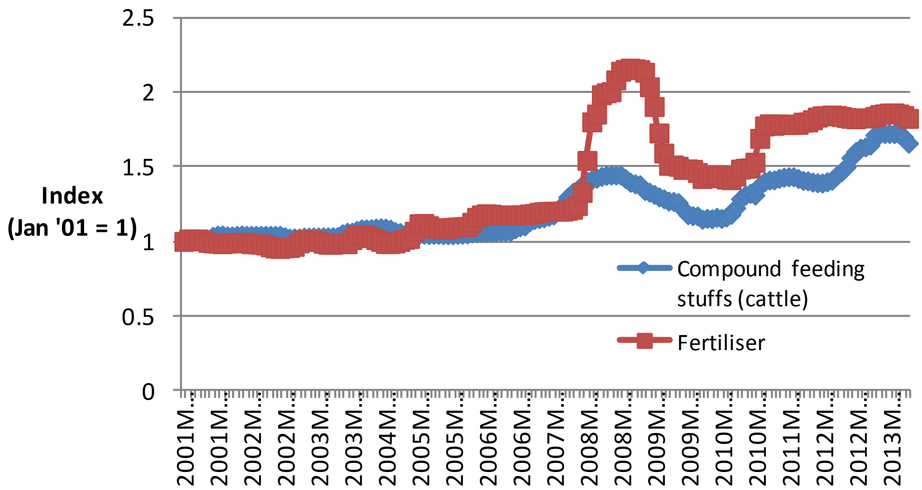

Figure 2: Index of Irish Monthly Feed and Fertiliser Prices 2001 – 2013

Variation in All Components of Dairy Farm Income

Based on the data presented above on outputs and costs, it is not surprising that there are concerns over the increased role of risk in the dairy farm business. Further on in the paper various methods to manage risk will be presented. But before these methods are outlined one must first quantify the important sources of dairy farm income variability. It is only then that farmers can begin to control fluctuating incomes through business and financial management strategies.

Here we use Teagasc National Farm Survey (NFS) data to indentify the major sources of dairy farm income risk. This is accomplished by decomposing the variability in Family Farm Income (FFI) by major sources of risk over a 6 year period (2007 – 2012). Figure 3 below outlines the results of the decomposition analysis organised into five groups: variability in gross output, variability in direct costs, variability in subsidies, variability in overhead costs and variation in the covariance between the afore mentioned items. For ease of presentation and to identify the relative effects of each component, it is convenient in the empirical analysis to normalise the direct and indirect effects by dividing each term by the total variance in FFI.

Figure 3 shows variation in FFI which is set at 100 for the time period shown, which is computed as the sum of the variation in direct contributors to FFI variance and indirect contributors to FFI. Gross output is the single biggest direct contributor to variance in FFI over time. However, co-variation between the individual components that make up FFI is relatively more important in determining overall variance in FFI over time. Indirect effects (or covariance) refers to the manner in which individual items which make up FFI, such as revenue and costs, are correlated with each other. The overall sum of the variance in the indirect contributors to variance is negative, this means that the correlation between important variables such as revenue and cost must not be ignored because in doing so the overall variance in FFI would be overstated.

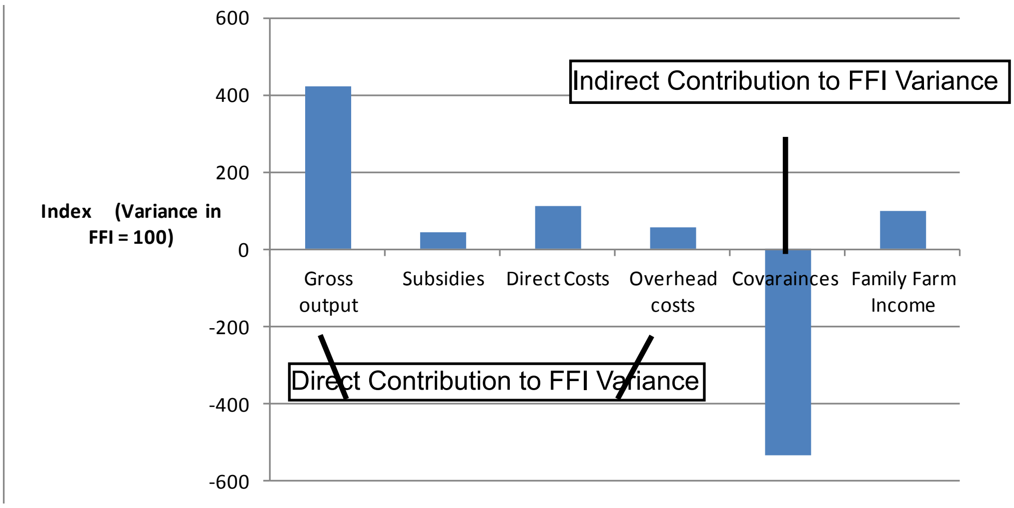

Figure 3: Decomposition of Variance in Family Farm Income (2007 – 2012). Based on data from Teagasc, National Farm Survey.

Research Findings on Farmers Attitudes to the Main Sources of Risk

There are five sources of risk which have been identified for businesses and these risks can also be applied to farming business, as follows:

a. Production. For dairy farmers the production risk relates to the system of production and how efficient a producer one is. Many factors, including herd genetics, grassland management, and weather all have a bearing on the farm efficiency.

b. Personal. How effective is farmer as the manager of the business? This also includes labour (hired and family), personal health, education, experience, and family succession.

c. Financial. This risk is often related to the health of the economy. Producers of commodity type products are more sensitive to movements in the economy. Relationships with banks, and interest rates (EU economic health), cash flow, the equity position of the farm, and off-farm income are all contained within this risk heading.

d. Market. Milk price is contained within this category of risk, as are cattle and heifer prices, concentrate and fodder prices, and other input prices. Removal of milk quotas will ultimately have an effect on the price volatility; will your business cope if there is for example a 15cpl fluctuation in milk price? Having a unique product (e.g baby formula or high EBI heifers) helps to reduce the impact.

e. Institutional. EU policy is the main institutional risk. Others include tax policies, laws and regulations that allow partnerships. Also included are limits on the amount of N and P that can be used and slurry storage capacities. How compliant the farm is and the cost of keeping within compliance limits need to be determined, for example if one were to expand the herd by 50%.

The remainder of this section of the paper reports results from research findings on the attitudes of farmers towards the various sources of risk at farm level (identified above). Two different data sources are used here: (i) results from a focus group of farmers and advisers at the Greenfield Open day in September 2013 and (ii) results from the Teagasc National Farm Survey.

Analysing Farmers Attitudes to Risk: Greenfield Results from Risk workshop on 4th September 2013

On the 4th September 2013 a dairy expansion workshop was held at the Greenfield Dairy Site in Kilkenny. Twelve groups with 18 farmers in each group, facilitated by advisers were asked to discuss "Risk" and given an one hour time frame in which to do so. The participants were asked to list items of "Risk", rate how important each of these risks are (using a formula provided) and then come up with ideas on how to manage or reduce the risks discussed. The farmer attendees were predominately Teagasc dairy discussion group members with a long history of dairy farming, but also included some "new entrants" to dairy farming.

The main part of the discussion focused on the concept of placing an importance rating on each of the risks discussed. The scoring method used the interaction of two elements of risk i.e. the "likelihood" of the event occurring and the "impact" of the occurrence of the event. Both of these elements were scored from 1 to 5, (5= high frequency and 5 = high impact). The scores were multiplied by each other and used as the basis to rank the risks.

Attaching a score to each element, a final risk ranking profile was produced and farmers thereby ranked the top 4 risks in their groups. The overall rankings results were as follows:

- All except one of the groups listed Milk Price as the top risk.
- Animal Disease was ranked as the second risk by all but one of the groups
- Labour was the third, and
- Banks/Interest rates was the 4th most important risk.

The last part of the workshop involved a discussion on how to manage or mitigate the risks. The same groups of farmers were asked how they might manage the risks that they identifed. A summary of the findings on how to manage the risks are contained in the Appendix to this paper.

Teagasc researchers at the Greenfield farm produced a Risk Assessment document for the Greenfield farm which comprised of a table to identify the risk, assign a likelihood and a severity score if it were to happen, the cost if it happened, management actions and costs to prevent it from happening, as well as early warning signs[6].

6 This can be found on the Greenfield dairy website at the following website address http://www.Greenfielddairy.ie/files/image/workshop%203%20risk%20analysis%20how%20to%20run%20workshop%203.pdf

Analyzing Farmers Attitudes to Risk: National Farm Survey results

In this section, we provide empirical analysis in relation to the risk factors faced by Irish dairy farmers in their farming operations. The results are based on data from the 2011 Teagasc National Farm Survey (main survey) and an additional survey carried out by the Teagasc National Farm survey team in Autumn 2011. We concentrate our analysis on the 231 farms which supplied responses to both the additional survey and the main 2011 Teagasc National Farm Survey. Among many other questions, the autumn survey asked farmers to rank five sources of risk on their farm (from 1 - 5) according to their relative importance. The most important factor was given a value of 1 and the least important a value of 5.

The five risk factors listed in the questionnaire were:

- market risk i.e. price volatility;
- production risk i.e. weather variability, pest and animal disease;
- personal risk i.e. health, accidents, lifestyle, successor;
- institutional risk i.e. changes in environmental standards, changes in subsidies; and
- financial risk i.e. changes in interest rates charged on debt.

From Table 1 below, we can ascertain the average ranking for each risk factor.

Table 1: Farmers Attitudes to Risk (Teagasc NFS, Autumn 2011)

Average Ranking Position	Risk Factor	Average Ranking
1	Market Risk	1.75
2	Production Risk	2.43
3	Personal Risk	3.08
4	Institutional Risk	3.40
5	Financial Risk	4.35

It is evident from Table 1 that market risk was considered to be the most important risk factor. This result supports the findings of the dairy expansion workshop which took place on the Greenfield dairy farm outlined earlier in the paper.

The above results show that production risk was considered on average to be the second most important risk factor. This suggests that weather variability and animal disease are among the more serious threats faced by dairy farmers. This is also supported by the findings of the Greenfield workshop. In terms of the other three risk factors, we found that personal risk was given an average ranking of 3.08. Farmers therefore considered this factor to be of roughly average importance relative to other factors. Institutional risk had an average ranking of 3.4 suggesting that changes in environmental standards and subsidies pose less risk to dairy farmers than personal, market or production risk. Many farmers considered financial risk to be the least important factor and this was reflected in the average ranking of 4.35 (ranked 4th in the Greenfield workshop). The average ranking for financial risk is perhaps a little surprising given the large debts faced by many dairy farms.

Explaining Market Risk concerns

Approximately half of the dairy farmers interviewed in the NFS survey considered market risk as the most important risk factor. This means that the sample of farmers was split almost evenly between two groups i.e. those citing market risk as the biggest risk factor and those farmers citing one of the other four factors as being most important. Additional analysis was conducted to determine whether or not these two groups differ in their farm characteristics. The findings from this analysis suggested that those farmers that cited market risk as the most important risk factor had on average higher levels of milk production, larger farm size and herd size relative to farmers that cited other factors as the most important. The size of the dairy operation therefore appears to be highly correlated with the farmer's perception of market risk. Interestingly, there was little difference in family farm income between those farmers citing market risk as the biggest factor and those farmers that cited other risk factors as being most important. We found that profitability per cow was actually higher among those farms that cited other factors as being most important.

Some of this can be explained by differences in the costs of production. Farmers that considered market risk as most important appear to have higher costs of production making them more vulnerable to fluctuations in the milk price. It is also interesting to note that that the participation in the e-Profit Monitor programme is less common among those farmers citing market risk as the most important source of risk relative to those farmers citing other risks as most important. Approximately 40% of those farmers citing market risk as most important are participants in the e-Profit Monitor programme. This compares to a 51% participation rate for those farmers citing other risks as most important. Hence, it could be said that the research findings to date from this analysis indicate clear reasons as to why different groups of farmers consider alternative sources of risk more important than others, the rankings being applicable to their particular farm situation.

Explaining Attitudes to Risk

While the previous section explained that different categories of farmers exist in terms of attitudes to sources of risk, it is also important to understand that farmers can also be categorised in terms of their more global attitude to risk. People are different in how they react to risk. When was the last time you were in a casino, or bought a lottery ticket? How about your neighbour or your sister? There are four broad attitudes in ones inherent attitude to risk:

- Avoiders. This farmer never sells milk above their quota limit. They are very cautious. The farm operation is generally stable so he may miss out on opportunities that involve in going outside his comfort zone.
- Calculators. This farmer always plans on selling 5-10% more milk than quota, but keeps a close eye on where the co-operative stands. He keeps a close eye on the quota situation but sometimes he over analyses.
- Adventurers. This farmer will start the year with a hope to produce 15-20% over quota. Then as the season progresses, will begin to sweat as he wonders what to do. He feels risks are a challenge and enjoys the excitement of it, but his adviser keeps reminding him to keep his stakes at a reasonable level
- Daredevils. If the cows are milking well, this farmer will keep on milking, and then try to find a way to pay the super levy. This type of person often fails as they ignore the facts and take no precautions, sometimes they get lucky.

What options are available to deal with or to reduce risk at the farm level?

Following from the previous sections in the paper which have outlined how risk has become a more important feature of the dairy farm business in recent years, this section of the paper will deal with different ways in which the dairy farm operator can manage or mitigate these risks.

The farm operator, possibly because of his/her inherent attitude towards risk, can adopt various strategies in response to farm level risk which may be categorised as follows:

- Control. This is something as simple, and important, as making sure that the lights on farm vehicles and trailers work. Are the fences around the slurry pit child-proof?
- Avoid. This farm does not take groups of visitors on their farm. That farm does not use a bull, ever.
- Retain. This farm has a very high deductible health insurance policy €10,000, so they pay the clinic when they are sick, but they are protected from a high hospital bill for a prolonged hospital stay.
- Transfer. Most farms have insurance policies that transfer certain risks to an insurance company. Insurance is a way to allow the farm to keep going in the face of two of the 'Ds': death and disability.

- Ignore. This farm hopes that the silage "wagon wheel", the one with the bad bearing, will make it through the season without a breakdown.

There are a broad range of instruments, both in the public and private market, which may be utilised to manage price and income volatility. With regard to the private market, the available suite of instruments includes over the counter contracts (OTC), forward contracting, futures contracts and insurance contracts. Examples of these private market measures include the Glanbia Fixed Milk Pricing scheme announced in late 2010. This scheme locks a percentage of a farmer's annual quota at a fixed base milk price for three years.

Summary

In this paper, we have identified the main sources of risk on Irish dairy farms using information gathered from both the Greenfield dairy expansion workshop of September 2013 and detailed farm level data taken from the 2011 Teagasc National Farm Survey and autumn survey. In addition, we have utilised Teagasc National Farm Survey data from 2007 to 2012 to examine the factors driving variability in family farm income on Irish dairy farms during that period. The paper outlines some of the different attitudes to risk in dairy farming and outlines methods that can be used by farmers to manage these risks at the farm level.

In terms of the empirical analysis, we find that the Teagasc NFS results confirm many of the findings of the Greenfield workshop. Price volatility is considered by farmer respondents as being by far the biggest source of risk. This dominance is clear from both the Teagasc results and the Greenfield workshop results. The rise in milk price volatility since 2007 is likely to be a big contributor to this risk perception. Our analysis of the Teagasc NFS data points to farm size, the level of milk production and the costs of milk production as being important factors in determining whether or not market price is perceived by the farmer to be the most important risk factor. We find that farmers participating in the e-Profit Monitor programme are less likely than non-participants to cite market risk as being the most important source of risk.

Our analysis of Teagasc NFS data shows that gross output has been much more variable over time than direct costs or family farm income and is the single biggest direct contributor to FFI variance over time. This result is partly driven by the high volatility in milk prices in recent years. It appears that there is a strong negative correlation between many of the components of gross output such as revenue and costs. We should therefore be careful to not over-attribute the variability in gross output to any one component.

Farmers can be categorised in terms of their "global" attitude to risk in that each farmer is different in how he may react when faced with a risk. Literature in the area of risk classifies people into four broad "attitudes" to risk. Additional research conducted by Teagasc using the Teagasc NFS ranking farmers according to their risk attitude, which is beyond the scope of this paper will be published over the coming year.

In outlining the options available to farmers, in managing or reducing risks on their farm, we pay attention to a wide range of risk factors encompassing farm safety, health and financial risk. Farmers can adopt a range a strategies which include controlling, avoiding, retaining, transferring or ignoring these risks. Some of these risk strategies can have a very high impact on the dairy farm and the household while others pose less of a threat to the future of the farm.

In conclusion, it can be said that the research findings outlined in this paper have shown that risk (in its many forms) has become an inherent part of the dairy farm business in recent years. Depending on the individual's inherent attitude to risk, some elements can be considered desirable but the principles of economics suggest a set of mostly negative consequences of extreme volatility for producers. Consequently, the ever increasing role which risk is playing in the dairy farm business must be managed at some level. Various instruments, both in the public and private market, which may be utilised to manage price and income volatility, will play an ever increasing role in the business and financial strategies of the dairy farm business.

Appendix

Greenfield Workshop Results – September 2013

A summary of the findings and words used by farmers on how to manage or mitigate the risks:

Milk Price:

" No capital purchases, cut costs, budgeting, savings when the price is high, sell stock, go to interest only on loans, operate a low cost system, put money away when price is high, use fixed price contracts for a proportion of supply, supply high milk solids , Profit Monitor to measure efficiency. "

Animal Disease:

"Bio security, vaccinations, buy cows from one farm, surplus replacements, quarantine, bulk milk sampling, closed herd, fencing, herd health plan, test animals."

Labour:

"Defined work roles, insurance, stay with 1.5 employees until you need the second person, increased control over people, project management, critical illness cover, FRS cover, infrastructure, be careful, talk with employees about safety"

Bank/interest rate:

"Have fixed rate loans, prepare a cash flow statement, sell assets, restructure loans, move, to interest only, and be proactive with banker."

The table presented below was used at the Greenfield workshop for the purposes of calculating the cost of a risk event occurring.

Table 1: Calculating the cost of a risk event occurring

Risk Assessment – Worksheet for Your Own Farm								
Risk	Likelihood	Impact	Score	Timescale	Cost if happened	Management Actions	Management Cost	Early Warning Signs

Focusing on some of the risks mentioned and discussed at the workshop, the management of the Greenfield farm in Kilkenny have made the following decisions for some of the identified risks:

Table 2: Greenfield farm – Management decisions

Risk Assessment of Greenfield dairy farm phase 2(Year 4 of 15 year plan)								
Risk	Likelihood	Impact	Score	Timescale	Cost if happened	Management Actions	Management Cost	Early Warning Signs
Low Milk Price	Very High (5)	Very High (5)	25	Anytime	+/- 3c/l= €43,500 milk sales	**Low Milk Price** • Ensure you get high milk solids from good grassland management, & breeding • Reduce costs of production • Prepare business plan on a realistic milk price	€120,000 banked for rainy day- equivalent of 8c/l	Markets changing
Labour Can a replacement be found easily Is the system easy to understand?	High (4)	Very High (5)	20	Anytime	• Drop in milk solids (4c) • Higher mortality (1c) • Drop in other revenue (1c)	**Labour** 2nd in charge should be fully trained to take over farm manager	6c/l is the total cost of labour including PRSI etc	Staff injured No early warning signs

An International Perspective on Dairy Herd Fertility[7]

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Summary

- Different countries have different philosophies in terms of managing reproduction of dairy cows. The United States perspective is that every available tool should be applied to efficiently manage the reproduction of postpartum cows.
- Genetic selection for fertility is performed in the United States and this will lead to high milk producing dairy cows with superior fertility. The synchronisation programmes that we use today may not be necessary in the future because cows will have superior fertility with minimal intervention.
- Now is the time to define "high fertility". Cows that require hormonal interventions in order to become pregnant should not be scored as "high fertility" within genetic selection programmes.

Introduction

The innovation of artificial insemination (AI) meant that people (and not bulls) had to determine when a cow was in heat (oestrus). This simple fact changed the direction of reproductive management as dairy herds increased in size during the latter half of the 20th century. Heat detection was not necessarily a difficult task on a small dairy farm but it did take considerable time. It was also necessary to understand the behaviour of cows in general and in some cases the unique behaviour of individual cows. What dairy producers in the United States found was that the scale with which they needed to approach reproduction grew with the size of their dairy farm. Large dairy farms did not have the capacity to assess unique behaviours or manage the peculiarities of individual cows. Herd-level programs with well-defined standard operating procedures (SOP) needed to be in place so that herd fertility could be maintained.

Addressing Challenges in Reproduction in New Mexico (United States)

For the purpose of example, the author will use the state of New Mexico where the highest milk producing cows in the United States are found (11,500 kg milk/cow/year). New Mexico is located in the desert southwest; a region that receives approximately 500 mm of rainfall annually. Cows are fed a totally-mixed ration comprised of forages and concentrates that are grown under pivot irrigation. There are 172 dairy farms in New Mexico and the average herd size is 2,100 milking cows. Assuming a 30% replacement rate and a 14 month calving interval, a 2100 cow herd will need approximately 105 pregnancies every month. If we further assume a 35% conception rate to AI then 300 cows that are in heat need to be identified monthly.

Cows in New Mexico are typically housed in open dry lots with shade structures in the middle of the lots. Pen size varies but breeding pens with 400 to 600 cows are not unusual. Cows are identified by ear tags with 4 to 6 numbers. Correctly identifying 300 cows in heat every single month of the year and correctly inseminating the same cow is a tremendous challenge given the size of the breeding pens. Reproductive efficiency rapidly deteriorates if a reproductive management plan is not in place. Dairy farms that do not manage reproduction will need to purchase pregnant cows so that the size of the milking herd is maintained.

Heat detection and AI to achieve 300 inseminations in one month

Individual approaches to identifying and inseminating 300 cows every month are as different as the individual dairymen that manage each farm. There is clearly no "one way" to get the job done in New Mexico or elsewhere in the United States. For some producers, a simple programme of "walk and chalk" provides an adequate number of pregnancies each month. Cows are "locked down" via locking head locks after morning milking and their tail

7 The author would like to thank the Fulbright Commission/EducationUSA, the University of Missouri, and Teagasc for supporting the author's research leave in Ireland.

chalk is examined to see if it is rubbed off. Morning lock down will be for all cows in the breeding pen (i.e., 400 to 600 or more cows depending on the dairy farm). Cows with rubbed tail heads are inseminated and all other cows have their tail chalk "touched up" as necessary.

The "walk and chalk" system works because cows are inseminated during morning lock down if their tail chalk is rubbed off (i.e. detection of oestrus and insemination occur at the same time). The AI tank with the semen and equipment for AI are carried on a four wheeler that is driven behind the cows. All cows have radio frequency identification (RFID) ear tags. The ear tag is read with a wand and her ID is loaded directly on to a handheld device so that the information can be downloaded to the herd computer after all inseminations are completed. Insemination straws are bar-coded but at this time most producers are not attempting to scan and upload the information on the bar codes.

Timed AI to achieve 300 inseminations a month

The "walk and chalk" method works well for many producers and it is widely practiced. Other producers will employ oestrous synchronisation and timed AI to achieve the required number of pregnancies. The first timed AI programme, now legendary within the dairy industry, was Ovsynch. The Ovsynch program involved a series of injections (GnRH, PGF2α, and GnRH) that synchronised ovulation so that AI could be performed at a predetermined time. The Ovsynch program has been modified over time so that it fits into the daily management routine of individual dairies (Figure 1).

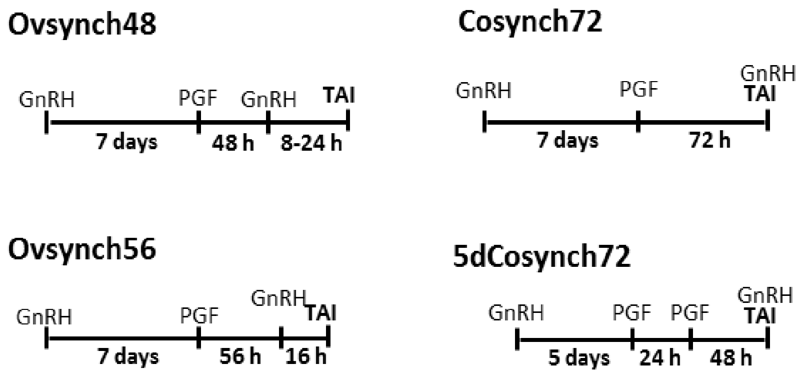

Figure 1: "Ovsynch" programmes used for timed AI in dairy cows in the United States. The programmes involve a series of injections (PGF2α or GnRH) that synchronise ovulation to at timed artificial insemination (TAI).

Ovsynch probably would not have achieved widespread application in the dairy industry had it not been for the subsequent development of presynchronisation ("presynch") programmes that were administered before the Ovsynch. The presynch programmes typically involve an additional series of injections to ensure that cows start on the Ovsynch programme between day 5 and 10 of the oestrous cycle (optimal time). Presynch improves the conception to Ovsynch by 5 to 10 percentage points. Three very common timed AI programmes that involve a presynchronisation step are depicted in Figure 2 (Presynch Ovsynch, Double Ovsynch, and G6G).

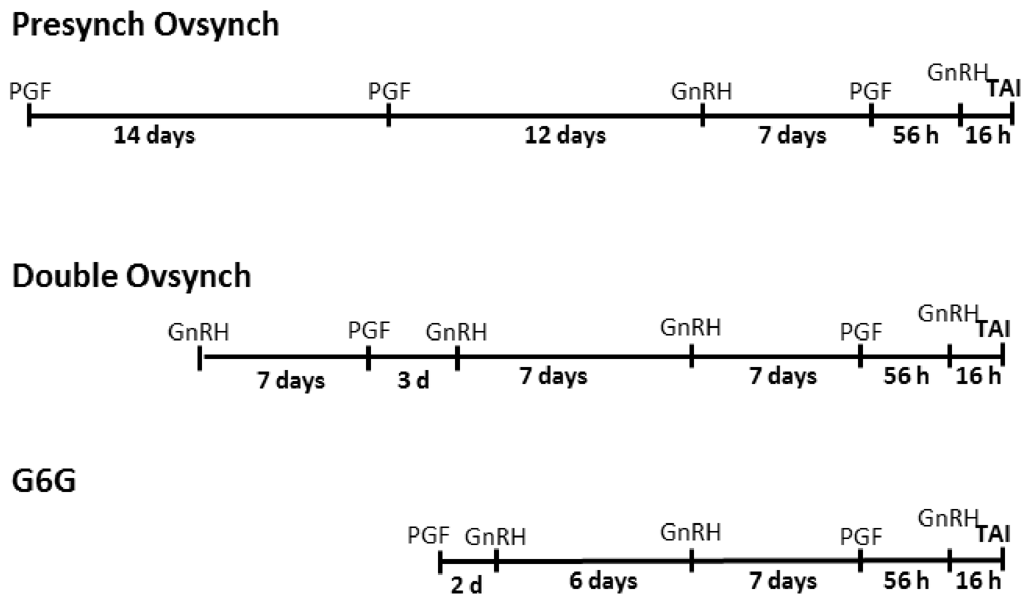

Figure 2: Programmes used for timed AI in dairy cows in the United States that use a presynchronisation step before the Ovsynch. Cows that come into heat during the presynchronisation period can be inseminated or may continue on the full programme.

Presynchronisation adds to the number of injections that a cow receives. If a cow comes into oestrus during the presynch period (in response to a PGF2α injection, for example) then she may or may not be inseminated. If she is inseminated then she receives no additional treatment after AI. If she is not inseminated then she continues on the programme until timed AI.

Large scale timed AI programmes described in the previous paragraphs would not be possible without dairy management software and RFID. Cows are grouped into weekly cohorts based on calving date. Depending on the size of the dairy, these cohorts will typically have 100 to 200 cows (this includes first insemination and repeat insemination cows). The date of first insemination is scheduled based on the day of calving. Injections are given and inseminations are performed on specific days of the week. To implement the systems, pens are locked down after morning milking and each cow is identified by RFID via a hand held wand. The wanding serves two purposes - animal inventory and also identifying cows that need treatment. Large numbers of cows can be screened quickly via RFID and treatments are applied and entered into the handheld device attached to the wand. Injections are administered with pistol grip syringes that deliver 10 to 20 doses between refills. Large numbers of cows can be inventoried and treated in less than 1 hour.

A key component of the timed AI system is that it is not necessary to read ear tags. Furthermore, the people doing the work do not work with lists of cows written on paper. Reading ear tags and working with paper lists are too slow and their inherent error rates are too high for the successful implementation of a timed AI programme.

Managing Cows that are Not Pregnant after First AI

One-half to two thirds of cows that receive a first insemination will need additional inseminations before the cow becomes pregnant. The traditional method of identifying the non-pregnant cow was to watch for heat approximately 3 weeks after first AI. Cows that come back into heat (return to service) are assumed to be not pregnant. If the "walk and chalk" method is used then return to service cows are inseminated when the chalk is rubbed off the tail head.

A popular alternative to waiting for cows to return to oestrus is to place all cows onto a resynchronization programme for second AI. A simple resynchronization programme is to perform pregnancy diagnosis and then place any non-pregnant (open) cow back onto an Ovsynch program. This ensures that the cow will be reinseminated in about 9 days. Some producers opt to start the Ovsynch (GnRH injection) one week before pregnancy diagnosis. This saves time because cows can be given PGF2α if they are not pregnant at the time of pregnancy diagnosis and then timed AI 2 to 3 days later.

Saving Time by using Chemical Pregnancy Diagnosis

Chemical pregnancy diagnosis enables the detection of nonpregnant (open) cows sooner after insemination. At this time, commercially available pregnancy associated glycoprotein (PAG) tests can detect pregnancy at 25 days after insemination. In all likelihood, future tests for pregnancy will decrease further the interval between insemination and pregnancy detection. Shortening the interval between insemination and pregnancy detection enables a shorter interval between successive inseminations for herds performing synchronisation and resynchronisation.

A sample synchronisation programme with a resynchronization is depicted in Figure 3. In this example, we compared beef cows that were timed AI and then resynchronized for a second timed AI. The identical programme works well for the University of Missouri grass-based dairy herd in Mount Vernon, Missouri. The second timed AI programme (resynch) was started at 17 days after first AI. A chemical pregnancy diagnosis (PAG test) was performed on a blood sample collected 25 days after first AI. Cows that were not pregnant were treated with PGF2α and timed AI three days later. There was no heat detection in the synch-resynch cows. Control cows were timed AI for first insemination and then placed with a bull. The results were that 82% of the synch-resynch cows were pregnant with an AI calf (Table 1). The 82% pregnancy rate was achieved in 28 d (time between first and second AI). There was no heat detection and all work was completed on three Mondays and three Fridays over a six week period.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					Nov 30 CIDR in GnRH	Dec 1
Dec 2	Dec 3	Dec 4	Dec 5	Dec 6	Dec 7 CIDR out PGF	Dec 8
Dec 9	Dec 10 GnRH and Breed AI	Dec 11	Dec 12	Dec 13	Dec 14	Dec 15
Dec 16	Dec 17	Dec 18	Dec 19	Dec 20	Dec 21	Dec 22
Dec 23	Dec 24	Dec 25	Dec 26	Dec 27	Dec 28 Resynch cows: CIDR in GnRH	Dec 29
Dec 30	Dec 31	Jan 1	Jan 2	Jan 3	Jan 4 Blood test for pregnancy ___________ CIDR out Open cows: PGF	Jan 5
Jan 6	Jan 7 Open cows: GnRH and Breed AI	Jan 8	Jan 9	Jan 10	Jan 11	Jan 12

Figure 3. Example of a synchronisation-resynchronisation calendar used to achieve 100% submission rate for first AI and second AI (cows open at preg check). The programme employs a blood test for pregnancy on day 25 after first AI.

Table 1: Results from a timed AI and timed AI with resynch program (diagramed in Figure 3). The control was a timed AI alone for first insemination with bulls breeding cows thereafter. Bulls achieved about the same number of pregnancies but the percentage of cows carrying an AI calf was greater when cows were resynchronized.

Treatment	N	Preg. Per AI for first timed AI	Preg. per AI for resynch timed AI	% of cows carrying an AI calf	% of cows carrying a bull-bred calf	% of pregnant cows
Timed AI alone	50	29/50 (58%)	-	29/50 (58%)	19/50 (38%)	48/50 (96%)
Timed AI with Resynch	51	36/51 (71%)	6/13 (46%)	42/51 (82%)	5/51 (10%)	47/51 (92%)

What Does the Future Hold for Timed AI in the United States?

There is the possibility that consumers will increase their control over methods used in dairy production and force legal practices out of existence. This was recently done when recombinant bovine somatotropin (rbST), a federally approved and legal animal drug in the United States, was forced out of the marketplace in many regions when concerns over the healthfulness of milk arose. Estradiol cypionate was removed from the market in the United States because of potential consumer concerns about its use in lactating cows. Similar concerns, founded or otherwise, could arise for PGF2α, GnRH, and progesterone particularly when they are blanket applied in timed AI programmes.

Cows are observed for oestrus because oestrus is the best predictor of ovulation. Timed AI programmes are used because they do essentially the same thing (enable us to know when ovulation will occur). If timed AI programmes are forced out of existence then we will need to be detect cows in oestrus or, alternatively, be able predict when a cow will ovulate.

If the past is any indicator of the future then it is safe to assume that the way we manage dairy cows in the United States today (heavy emphasis on synchronisation and resynchronisation) will change in the next 50 years. In all likelihood the emphasis that is currently being placed on the underlying genetics of reproduction (see below) will create a permanent fix to infertility in dairy cows and obviate the need for synchronisation and resynchronisation programmes on dairy farms. In the short-term, however, the consensus is that the programmes work well and provide a sustainable level of fertility on farms.

It is very unlikely that we will return to the recommendation of twice-daily 30 minute observation of oestrus. The time (30 minutes) for oestrus detection is too short and herds are too large to achieve efficient reproduction using this approach. Automated methods for detection of oestrus will come of age in the next 100 years. Several new activity monitoring systems have been introduced into the United States in the past 5 years. Although the new monitors are technologically superior to the old systems, they essentially rely on a premise that has been in existence for a long time (cows in oestrus are more active). High production cows in oestrus, however, are less active compared with low production cows in oestrus. This fact may blunt the utility of these programmes in the next century.

Automated milk progesterone systems (DeLaval Herd Navigator System, for example) provide an interesting new alternative for dairy producers. Oestrus is preceded by a drop in milk progesterone concentrations. By monitoring milk progesterone, therefore, it is possible to predict (approximately) when a cow will be in oestrus. The question is whether this approximation will be good enough for routine AI. In addition to potential application for timing of AI, milk progesterone systems offer a unique opportunity to perform pregnancy diagnosis based on sustained elevated concentrations of progesterone in milk.

Improving the Underlying Genetics for Fertility

One reproduction lowlight of the past 50 years was that the dairy industry failed to include reproduction in their selection indices until reproduction had declined to unacceptable levels. This changed in the past 20 years. The United States uses a trait "Daughter Pregnancy Rate" (DPR) that was developed and introduced into Net Merit in 2003. The DPR is a function of days open. One unit of DPR is equivalent to 4 fewer days open. The trait is easy to score because the only information required are two consecutive calving dates (this interval minus gestation is equal to the days open that can be converted to DPR). The DPR has been included in selection indices and the inclusion of this trait along with the inclusion of productive life has been credited with reversing the decline in fertility of dairy cows. Genetic data demonstrate an improvement in dairy cow fertility over the past 10 years.

The cow genome sequence was completed in 2009 and this sequence is being used to develop genome-based methods to select for improved fertility. Genome-based selection will rapidly improve the fertility of dairy cows in the future. If genetic progress in fertility continues at the current pace then high producing dairy cows will be highly fertile within the next 100 years. There is no reason to assume that a cow cannot have a first service conception rate of greater than 90% if genetic selection is applied judiciously for a long period of time.

Now is the Time to Define "High Fertility"

Selecting dairy cows for improved fertility is a good thing and genetic selection is a powerful tool. Genetic selection as it is practiced today (genomic selection or otherwise), however, is a black box. The physiological mechanisms that lead to improved fertility are not important. The only important outcome is the improvement in fertility.

Given the black box of the genetic selection process, it is extremely important that the dairy industry define "high fertility" and adopt a genetic selection programme (no matter how difficult) that yields the desired "high fertility" cow. The current fertility trait in the United States (DPR) is a function of days open (interval from calving to pregnancy). For dairy systems that do not intervene with reproduction (i.e., do not use PGF2α, GnRH, and(or) progesterone treatment at any time and do not use timed AI) then DPR is an excellent fertility trait. Cows that are cycling, come into oestrus, are observed in oestrus (intense signs), are inseminated and become pregnant during the early postpartum period have the most desirable DPR. They are highly fertile because their reproductive system is fully functional. Cows that are not cycling or do not come into oestrus (silent ovulation) or have subtle signs of oestrus or do not become pregnant after insemination will have longer days open and a poor DPR. They are infertile because their reproductive system does not function when placed under lactation stress. The concern is that timed AI programs mask infertility by enabling otherwise infertile cows (non-cyclers, etc.) to become pregnant. These infertile cows may have a desirable DPR because they were timed AI and become pregnant early postpartum but their reproductive system does not function well independent of external intervention. If a genetic recording system is not developed that can account for the breeding interventions used in postpartum cows then we may find that 100 years from now our population of "fertile" cows are only "fertile" when treated with PGF2α, GnRH, and (or) progesterone and timed AI. The abrupt disappearance of synchronisation programmes could trigger another reproductive crisis in dairy cows.

Given the argument made in the preceding paragraph, it is absolutely essential that reporting of fertility data include additional information on the events leading up to the pregnancy. Cows inseminated after a natural heat should not be scored equivalently to cows that became pregnant after timed AI. The current system of DPR reporting in the United States does not differential between these two cows and this could lead to a population of cows with high fertility but only when treated for timed AI.

But what about the dairymen that want a cow that responds well to timed AI? Selecting cows for a functional reproductive tract is the best way to select cows that will respond well to timed AI programmes. The reverse argument may not be true; i.e., selecting cows that respond well to timed AI programmes may not lead to cows that also function well independently of hormonal intervention (timed AI).

Conclusions

There is no "one way" to achieve acceptable fertility in United States dairy herds. Most producers have the mindset that every available tool should be applied to efficiently manage the reproduction of postpartum cows. The current heavy emphasis on synchronisation and resynchronisation found in the United States today will probably lessen in the next 50 years. In all likelihood correcting the underlying genetics of reproduction will create a permanent fix to infertility in dairy cows and obviate the need to synchronisation and resynchronisation programmes on dairy farms. In the short-term, however, the consensus is that the programmes work well and provide a sustainable level of fertility on farms. Now is the time to define "high fertility". Cows that require hormonal interventions in order to become pregnant should not be scored as "high fertility" within genetic selection programmes.

Strategies for sustainable success: the right cow to drive performance

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1. Background.

Genetics, grassland management and financial planning are widely acknowledged as the three key pillars for profitable dairy farming in Ireland. In this paper we will review the development of the Economic Breeding Index (the EBI) since its introduction in 2000. We will examine industry uptake in the EBI, based on genetic trend analysis and then examine its role in helping farmers more accurately breed and select dairy herd replacements. In addition we will discuss one of the newer breeding technologies that is revolutionising Irish cattle breeding, genomics and postulate as to how this technology will be utilised in the future by growing numbers of dairy farmers.

2. EBI Development.

The EBI was first introduced in 2000, following extensive research, discussion and consultation with the Irish cattle breeding industry. Its introduction followed a period of sustained decline in the fertility performance of the national dairy herd throughout the 1990's, when due to the rapid importation of North American genes, average calving interval of the national dairy herd increased by some 20 days, from 375 days to 395 days (based on first to second lactation calving interval). New genetic evaluations for calving interval and survival were quickly developed and these were weighted, together with milk production traits, into an overall profit index (termed the EBI). This index then replaced the previous RBI, which was a relative breeding index, with 100% weighting on milk output traits. The economic values were calculated based on data from the Teagasc Moorepark Dairy Systems Model, with the initial relative weighting on fertility traits being 30%, compared to 70% for milk production traits (Figure 1).

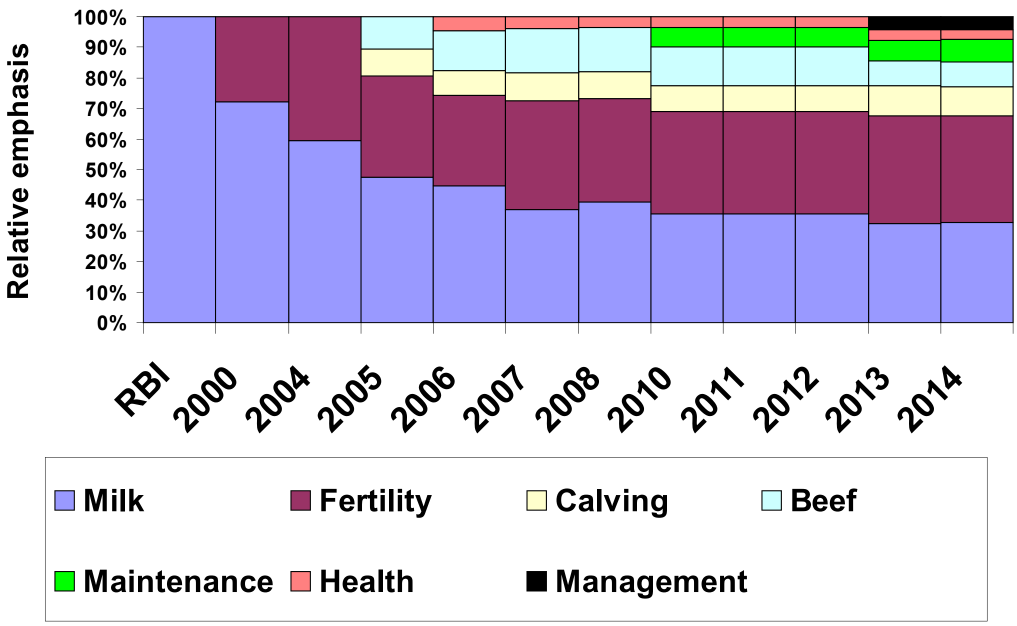


Figure 1. Relative emphasis of traits in the EBI from 2000 to 2014.

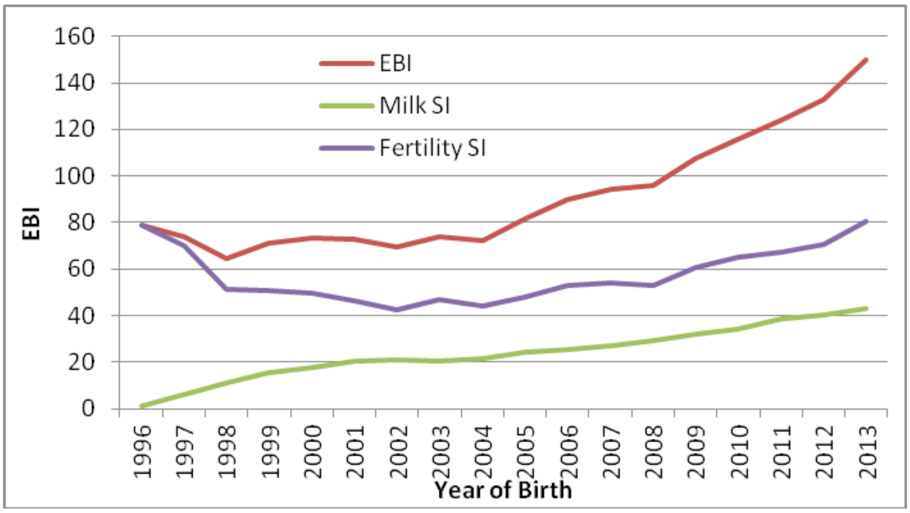
Since its initial introduction, the EBI has continued to develop as more information on traits, costs and assumptions became available to the ICBF and Teagasc teams. The net effect has been to develop a dynamic breeding tool that is being updated on a regular basis, with the overall objective of ensuring that Irish dairy farmers are always breeding animals that are some 5 years ahead of their current requirements.

Looking at the latest weighting for traits in the EBI (Figure 1) indicates a wide range of traits in the index, including female fertility traits (with a relative weighting of 35%), milk traits (31%), calving traits (9%), cow maintenance (7%), beef output (9%), health and disease traits (3%) and management traits (4%). It is expected that the relative weighting on "cost of production traits" will continue to increase in the future as costs continue to increase within the farm gate, relative to the value of dairy output.

3. Industry uptake in EBI.

Genetic trend analysis is the best way to evaluate uptake in the EBI, as it captures uptake by both AI companies (through their dairy AI offerings to farmers) and by farmers through their semen purchasing decisions and/or use of natural service sires. Looking at data from Figure 2 indicates a rapid increase in EBI over the past 10 years, with the trend even more notable for the last 5 years, where the average gain in EBI terms has been some €15/ year. This is a remarkable level of genetic gain, especially when one considers that prior to 2000 there was no gain in key profit traits, due to the fact that genetic gain for milk solids was effectively being negated by associated declines in female fertility performance. It wasn't until the EBI was introduced in 2000, followed by the G€N€ IR€LAND national breeding program in 2005 and genomics in 2009, that we started to achieve a rapid increase in genetic merit for key profit traits. As a consequence, we are now achieving a balanced improvement in both milk solids output and fertility performance, reflecting the high relative weighting of these traits within the index.

Figure 2. Genetic trends in EBI, milk solids and fertility sub index for females born during the period 1996 to 2013.



4. Does the EBI work?

With such a high level of genetic gain under way (Figure 2), it is prudent to ask as to whether the EBI is actually delivering "on the ground" in terms of improved phenotypic performance for farmers and the industry. In answering this question, we will examine data from the ICBF database, with the specific objective of establishing whether dairy heifers selected on the basis of parent average EBI have performed better than average animals for key profit traits such as milk solids and fertility.

In answering this question, we have extracted data from the ICBF database for herds involved in the Dairy Efficiency Programme (some 6000 herds in total). A total of 95,395 heifer calves born between 1st January 2008 and 30th June 2008 were included in the analysis. Animals were grouped into five categories based on parent average EBI (20% of available EBI records per group), with the top EBI grouping having an average EBI of €123.9, with €42.8 coming from milk sub-index and €65.4 coming from fertility sub-index (Table 1). This compares to an average EBI for the group of animals of €76.5 and €21.7 for the low EBI group. In addition there were 4,361 animals with no EBI. Parent average EBI (as opposed to actual or latest EBI) was used to form the basis of the comparison (EBI's were taken from the January 2010 evaluation, when the animals were all still un-calved), as that index is then independent of the animals subsequent performance. In this sense it is the most accurate indicator of the value of EBI in helping to predict the future performance of an animal.

Table 1. Average EBI, milk and fertility sub-index, by EBI group*

EBI Group	Number animals	EBI	Milk sub index	Fertility sub index
Top 20%	18,206	€123.9	€42.8	€65.4
21-40%	18,207	€97.7	€34.6	€52.0
41-60%	18,207	€79.2	€30.8	€40.2
61-80%	18,207	€60.0	€27.9	€27.2
Btm 20%	18,207	€21.7	€24.4	-€1.1
None	4,361			
Overall	95,395	€76.5	€32.1	€36.7

** Based on parent average EBI.*

In evaluating relative performance each EBI group was then assessed for a number of key profit traits including; (i) number that had calved a first calf, (iii) number that had calved a first calf at the target of 22- 26 months of age, (iii) number that were now in their third lactation, (iv) number that had produced a target of 1000 kg milk solids (fat kg + protein kg).

Looking at average fertility performance for the group of heifers indicates that off the 95,395 animals in the analysis, 83.7% had a first calving, indicating that some 17% of dairy heifer never reach calving due to a combination of infertility and/or other health and disease traits. Of the heifers that reached calving (79,876 in total), 57,565 (or 60.3% of total heifers) calved at the target 22 to 26 months and 61.1% of the total animals had now started their third lactation. Looking at the performance of the high EBI animals relative to average or low EBI animals indicated that, on average, high EBI animals had consistently better female fertility performance for each of the criterion evaluated. In fact, looking at arguably the most informative female fertility criterion (% animals with a 3rd lactation record) indicates that for every 100 high EBI females born in Spring 2008, 65 high EBI females had started their 3rd lactation, compared to only 52 low EBI animals.

Table 2. Average female fertility performance, by EBI Group.

EBI Group	Number animals	With a 1st lactation record		Calved at 22-26 months		With a 3rd lactation record	
		Number	%	Number	%	Number	%
Top 20%	18,206	15,237	83.7%	12,703	69.8%	11,894	65.3%
21-40%	18,207	15,466	84.9%	12,208	67.1%	11,655	64.0%
41-60%	18,207	15,340	84.3%	11,488	63.1%	11,213	61.6%
61-80%	18,207	15,117	83.0%	10,592	58.2%	10,873	59.7%
Btm 20%	18,207	14,703	80.8%	8,243	45.3%	9,528	52.3%
No EBI	4,361	4,013	92.0%	2,331	53.5%	3,081	70.6%
Overall	95,395	79,876	83.7%	57,565	60.3%	58,244	61.1%

Another way to assess the performance of high EBI animals relative to lower EBI animals is to establish what % of animals have achieved a specific target in relation to milk production performance. Assuming that the ideal heifer calved at the target 22-26 months, and has now started her third lactation, a target level of minimum performance should be 1000 kg milk solids produced in the animal's life-time (kg fat + protein). Of the 95,395 involved in the analysis, some 36% have reached this overall target (34,601 animals in total), with 44% of the high EBI group having achieved this target compared to only 23% for the low EBI group.

Table 3. Number of animals that have produced 1000 kg milk solids, by EBI group.			
EBI Group	Number animals	Number that have produced target 1000 kg MS	% Total
Top 20%	18,206	8,027	44.1%
21-40%	18,207	7,359	40.4%
41-60%	18,207	6,553	36.0%
61-80%	18,207	5,925	32.5%
Btm 20%	18,207	5,725	31.4%
No EBI	4,361	1,012	23.2%
Overall	95,395	34,601	36.3%

Expressing the milk production performance figures in absolute terms (Table 4), indicates that the high EBI group of animals had an average age at first calving of 25.4 months, calving interval (1st to 2nd) of 390.6 days and milk solids of 1047 kg. This compares to 27.9 months, 411.7 days and 1051 kg for the lower EBI group. Whilst the lifetime milk solids (for lactations 1 -3) seems at variance with results from Table 3, the results can be explained due to confounding between higher levels of concentrate supplementation and herd EBI level.

Table 4. Comparison of female fertility and milk performance, by EBI group.				
EBI Group	Age 1st calving	CI Days (1-2)	CI Days (2-3)	Milk solids (1-3)
Top 20%	25.4	390.6	378.4	1047.0
21-40%	25.8	392.2	382.2	1022.1
41-60%	26.3	395.4	384.0	1015.4
61-80%	26.7	398.7	385.4	1008.8
Btm 20%	27.9	411.7	395.0	1051.3
No EBI	27.9	395.3	383.8	901.4
Overall	26.5	397.3	384.5	1024.0

Breaking the analysis presented in Table 4 into spring calving and winter calving herds separately, indicates that that the high EBI group of animals yielded an additional 93 kg milk solids when assessed based on performance within spring calving herds only (Table 5). Average fertility improvements were maintained at 2 months in terms of age at first calving and 10-15 days in terms of calving interval.

Table 5. Comparison of female fertility and milk performance for Spring calving herds, by EBI group.				
EBI Group	Age 1st calving	CI Days (1-2)	CI Days (2-3)	Milk solids (1-3)
Top 20%	25.2	388.8	377.1	1034.2
21-40%	25.6	390.7	380.7	1009.7
41-60%	26.0	393.4	381.9	991.0
61-80%	26.3	395.3	382.3	972.2
Btm 20%	27.3	401.7	387.9	941.6
No EBI	27.1	389.0	378.6	838.5
Overall	26.3	393.2	381.4	964.5

The net effect of the above analysis is to clearly demonstrate the value of having EBI information when making breeding, selection, purchasing or culling decisions on the farm. The most striking and obvious example is the farmer who is entering dairying or expanding his dairy farm business through the purchase of additional stock. To make this decision without knowledge of the EBI of the individual animals being purchased is a serious error of judgement (even after acknowledging the fact that such information has low reliability when expressed on an individual animal basis). However, in the same way as dairy farmers have become accustomed to using teams of bulls when using AI, the principle also applies when breeding or purchasing dairy stock. The bottom line is that farmers should consider the parent average EBI information of dairy heifers when selecting or purchasing breeding stock to enter the herd, as these will generate more profit in the future through a combination of improved fertility performance and increased milk solids production.

5. The role of genomics?

Genomics is a tool that is now widely used in the context of bull breeding decisions on Irish dairy farms (some 60% of total dairy inseminations used in Ireland this year were to young genomic bulls). However, its uptake in the context of female breeding decisions has been very slow, with only a small number of dairy farmers genotyping their heifers, as a means of more accurately identifying potential dairy herd replacements. Given the title of this talk ("strategies for sustainable success in the context of dairy cow breeding"), is this justified? In helping to answer this question we will again revert to data from the ICBF database, through an examination of milk solids and fertility performance of animals genotyped since the introduction of the ICBF "genomics for females" service in 2010. Since then a total of 8,988 dairy females have been genotyped, of which 1,168 were born between 1st January 2008 and 30th June 2010 and have completed a first lactation in spring calving herds.

Again breaking these animals into percentile groups based firstly on parent average EBI, indicates that, on average higher EBI animals had improved female fertility performance (as with the previous analysis). However, there was little difference in milk solids production in the first lactation reflecting the fact that; (i) differences in genetic merit for milk solids were small (€24 between top and bottom EBI groupings), and (ii) unlike previous analysis, this comparison was based on first lactations only the benefits of better milk solids performance more generally accrue over the lifetime of the animal).

Table 6. Comparison of female fertility and milk production performance, by EBI group*

EBI Group	EBI	Number animals	Age at first calving	CI 1-2 days	1st lact F+P kg
Top 20%	€157	233	24.5	370.5	366.1
21-40%	€133	257	24.5	378.1	383.4
41-60%	€118	246	24.5	376.4	384.8
61-80%	€101	253	24.4	370.2	372.0
Btm 20%	€59	179	25.1	373.4	376.1
Overall	€114	1168	24.6	374.1	375.4

* Animals ranked on parent average EBI. Data from spring calving herds only.

Repeating the analysis based on genomic EBI rankings indicates a significantly different outcome. For example, whilst the difference in fertility performance was maintained (and indeed further improved), the higher EBI group (based on genomic EBI), also had improved milk solids performance when compared against lower EBI contemporaries (+16.6 kg fat + protein).

Table 7. Comparison of female fertility and milk production performance, by EBI group*

EBI Group	EBI	Number animals	Age at first calving	CI 1-2 days	Average F+P kg
Top 20%	€222	266	24.4	374.0	380.1
21-40%	€184	249	24.5	372.4	379.6
41-60%	€155	243	24.2	373.7	381.6
61-80%	€125	238	24.7	372.1	372.0
Btm 20%	€66	172	25.3	378.5	363.5
Overall	€150	1168	24.6	374.1	375.4

* Animals ranked on genomic EBI. Data from spring calving herds only.

The reason for this difference is that the genomic EBI is using additional information on the animals own DNA (in addition to parent average performance) to more accurately identify animals that are expected to have improved performance in the future. This is reflected in the average EBI reliability for parent average EBI indexes (~30%), compared to ~50% for genomic EBI indexes. Indeed an examination of the relationship between parent average EBI and genomic EBI for the 1168 animals in the above analysis has indicated a correlation of 0.71 between the two indexes. Another way to express this difference is to compare the number of animals that change grouping when evaluated on the basis of parent average EBI compared to genomic EBI (Table 7).

*Table 8. Comparison of number of animals that change group based on parent average or genomic EBI**

	Genomic EBI					
Parent Average EBI	Btm 20%	61-80%	41-60%	21-40%	Top20%	Overall
Btm 20%	175	58	42	10	7	292
61-80%	61	90	70	43	27	291
41-60%	31	70	73	69	48	291
21-40%	14	56	64	90	66	290
Top20%	7	18	43	80	143	291
Overall	288	292	292	292	291	1455

** Full dataset used, 1455 animals in spring and winter calving herds.*

Using the above dataset, only 143 of the animals that ranked in the top 20% based on parent average EBI, were also ranked top20% when evaluated on the basis of genomic EBI (49% of the "expected" animals). Extending this to the top two categories of animals increases the success rate to 74%. This suggest that a high proportion of valuable animals (in terms of genomic EBI) are potentially being lost by dairy farmers that have surplus dairy heifers, as the general approach is to select a % to be kept as dairy herd replacements (generally 50% of the available stock), with the remainder then being sold.

The above analysis would strongly suggest a change in this approach is justified. Given the cost of genotyping a dairy female (€30/animal), the cost:benefit of genotyping all available heifers and then selecting the best on the basis of genomic EBI is easily supported based on improved phenotypic performance in the first lactation alone, never mind over the animals life-time. Whilst some farmers will see this as a large up-front investment (on average 30 replacement heifers/year * €30 = €900), a revisit to the opening statement of this paper regarding the key pillars of profitable dairy farming in Ireland (genetics, grassland management and financial planning) is critical. At a time when dairy farmers are constantly examining ways to improve the financial performance of their dairy farm, a switch to large scale adoption of this new genomic technology (for the identification of replacement females) is now necessary. There are additional advantages from a parentage verification perspective (which typically runs at 10-15% in most commercial dairy farms), as well as related national benefits through increased genetic gain for the industry and the removal of unfavourable recessive genes from the national cow population (e.g., BLAD, CVM etc).

6. Summary.

The benefits of better breeding are now widely acknowledged within the Irish dairy breeding industry, as evidenced by latest genetic trends within the national dairy herd. Furthermore, independent analysis of parent average EBI in relation to subsequent animal performance fully supports this uptake and should act as a catalyst for further uptake. The new catalyst will come in the form of the application of genomic technology in the selection of dairy herd replacements. Initial analysis from ICBF indicates substantial cost:benefits for farmers and the industry. Given the success of EBI in generating additional profit for Irish dairy farmers and the wider industry, we should encourage rapid adoption of this new technology on our dairy farms, and in doing so add another significant chapter to the EBI story.

The future role for sexed semen in Irish dairy farming[8]

Ian Hutchinson and Stephen Butler

Teagasc, AGRI Centre Moorepark, Fermoy, Co. Cork.

Summary

- Sexed semen is normally sorted to 90% purity (i.e., 90% heifers, 10% bulls).
- Conception rates of sexed semen are reduced compared with conventional semen.
- Early results from a field trial conducted in Ireland in spring 2013 indicate significant improvements in the fertility of sexed semen compared with previous data.
- Conception rates improved with increased duration since calving (cows) and greater BCS (cows and heifers).
- Modelling work identified faster, more profitable expansion with sexed semen
- Other benefits of sexed semen use include increasing the beef output from the dairy herd, improved biosecurity, and reduced calving difficulty.
- Best practice guidelines on the use of sexed semen will be published in spring 2014.

Introduction

With conventional semen (fresh or frozen), the likelihood of a heifer or a bull calf is roughly equal at 50 %. Sexed semen (90 % X-sorted) will alter this ratio to 90 % heifer calves and 10 % bull calves. Sperm can be sorted because sperm containing an X-chromosome (female offspring) contain approximately 4% more DNA than sperm containing a Y-chromosome (male offspring). The sorting process distinguishes male and female sperm by measuring differences in fluorescence following staining the sperm with a non-toxic, DNA-binding dye.

Relative to the number of sperm required for each AI straw, sperm sorting is slow. As a result, the number of sperm per sexed semen AI straw is lower than conventional AI straws (2 million sperm vs. 20 million sperm). Due to a combination of the lower dose and unavoidable sperm damage sustained during the sorting process, the fertility of sexed semen is reduced compared with conventional semen. Previous studies in the USA have found a reduction in conception rates using frozen sexed semen to approximately 75 to 80 % of those achieved with conventional semen. A study in NZ using fresh sexed semen indicated conception rates were approximately 94 % of those achieved with conventional semen. For example, if conception rates with conventional semen were 60 %, expected conception rates with sexed semen would be 56 % (fresh) and 45 % (frozen).

Field Trial

To date, there has been limited use of frozen-thawed sexed semen in Ireland, and fresh sexed semen has never been used. In spring 2013, a temporary sexed semen laboratory was established at Moorepark to facilitate a large field trial. The main goal was to identify the optimal strategy to employ sexed semen in Irish dairy herds. The trial compared four different types of semen (fresh conventional, frozen sexed, and two different does of fresh sexed semen) in cows and heifers as outlined in Figure 1. The lab operated 24 hours per day, 7 days a week. The Irish Cattle Breeding Federation (ICBF) recruited 394 herds onto the trial, and 110 AI technicians linked to the partner AI companies (Dovea Genetics, Munster AI and Progressive Genetics) carried out all the inseminations. Every day, three ejaculates were delivered to the sexed semen lab by the partner AI companies (2pm, 10pm, and 6am). The semen from the first three bulls was dispatched on the evening of April 16th for use on dairy farms all over the country on April 17th and 18th. This daily routine continued until the required number of inseminations was achieved. In total, the dairy trial involved ~15,000 units of semen.

8 The 2013 sexed semen field trial was a collaborative venture between Teagasc, ICBF, Sexing Technologies, Dovea Genetics, Munster AI, Progessive Genetics and NCBC. Financial support from ABP, Dawn Meats, Kepak, Slaney and the Agricultural Trust are gratefully acknowledged.

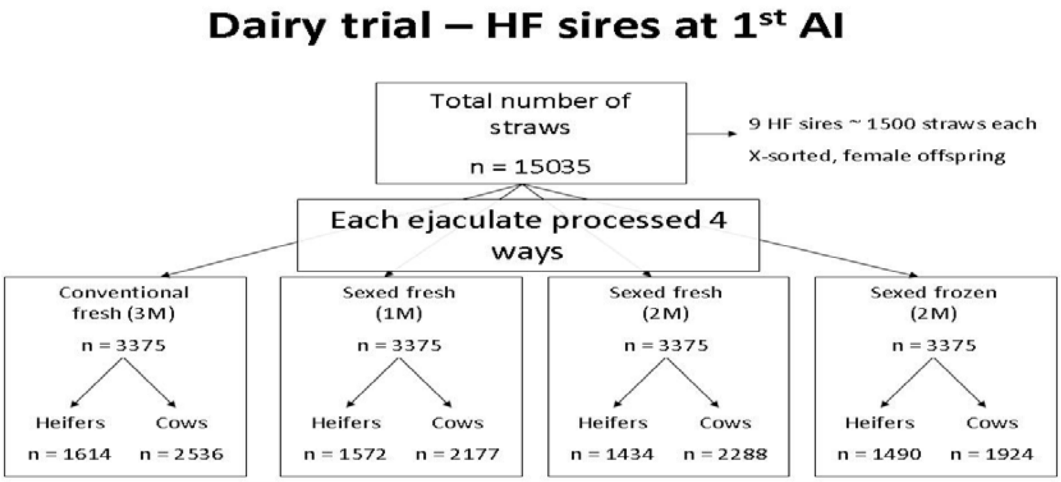


Figure 1: Experimental design of the sexed semen field trial conducted during the breeding season of 2013.

Preliminary results

A selection of animals (2,000 cows and 2,000 heifers) inseminated as part of the field trial were scanned for pregnancy diagnosis between 40 and 90 days post AI. The gender of the foetus was also determined in 820 pregnant animals across the four treatments. The preliminary results generated by this scanning work are summarised in Table 1.

The 2013 breeding season began in the midst of a sustained fodder shortage, and cows and heifers on many farms were below target BCS and weight, resulting in poorer than normal fertility performance. This was particularly true for heifers, where conception rates with conventional semen were well behind target and only marginally better than those in lactating cows. In many ways, this provided an ideal opportunity to test sexed semen; if it could work in a difficult year, it could work in any year.

Table 1: The effect of sexing on conception rate to first service and % of heifer calves in cows and heifers scanned 40-90d after insemination.

	Conception Rate to 1st Service	Conception rate as a % of Conventional	% heifer calves
Treatment	Cows		
Conventional	49%	100%	54%
Sexed Fresh 1m	32%	64%	88%
Sexed Fresh 2m	37%	76%	94%
Sexed Frozen	42%	85%	92%
	Heifers		
Conventional	53%	100%	56%
Sexed Fresh 1m	39%	75%	93%
Sexed Fresh 2m	46%	87%	87%
Sexed Frozen	46%	87%	90%

The preliminary results suggest that the fertility performance of the frozen sexed semen is much improved compared to previous reports in the literature, and outperformed expectations. The performance of the fresh sexed semen, however, was disappointing. The scanning results to date indicate that the expected 90% gender bias was achieved.

The excellent performance of the frozen sexed semen has beneficial implications for the future use of sexed semen in Ireland. The use of frozen sexed semen (rather than fresh) relieves the logistical pressures of transporting the semen from the bull stud to the sorting laboratory, and from the sorting laboratory to the farm in a short time period throughout the breeding season. The use of frozen sexed semen will also provide greater opportunity for DIY AI farmers to utilise the technology.

Body condition score data was also collected on the 4,000 animals that were scanned as part of the trial. Figure

2 summarises the effect of body condition score on conception rate to first insemination. These results are consistent with previous research conducted by Teagasc, and demonstrate a clear link between BCS and fertility. Days in milk at insemination has also been shown to have a significant influence on fertility (Figure 3). Cows that are longer than nine weeks calved at the time of first insemination will have a greater likelihood of conception compared to those with a shorter period from calving to first insemination. Detailed analysis of the full results of the field trial will be available following calving in spring 2014. The data collected will enable the publication of best practice guidelines on the use of sexed semen in Irish dairy cattle.

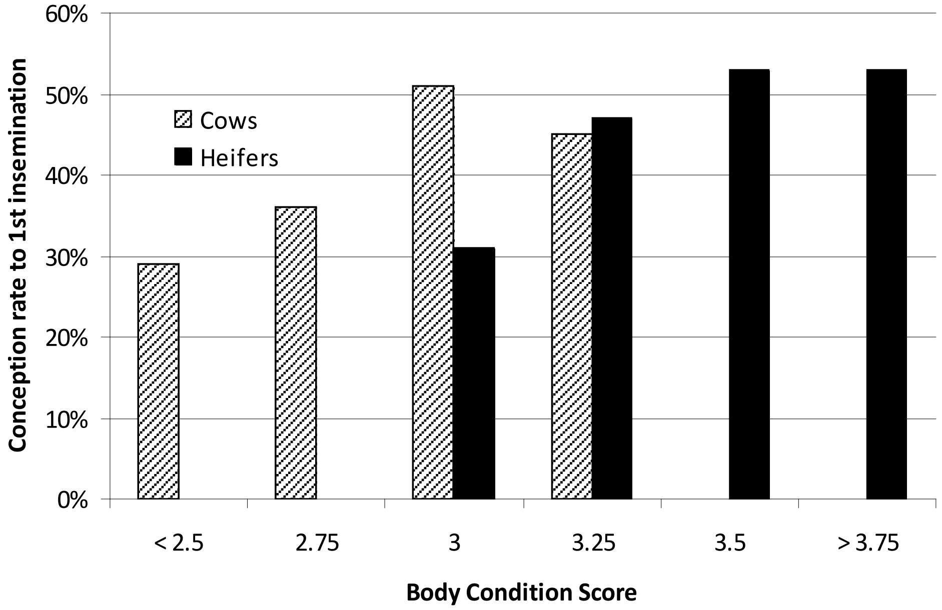


Figure 2: Effect of body condition score on conception rate in cows and heifers inseminated as part of the sexed semen field trial.

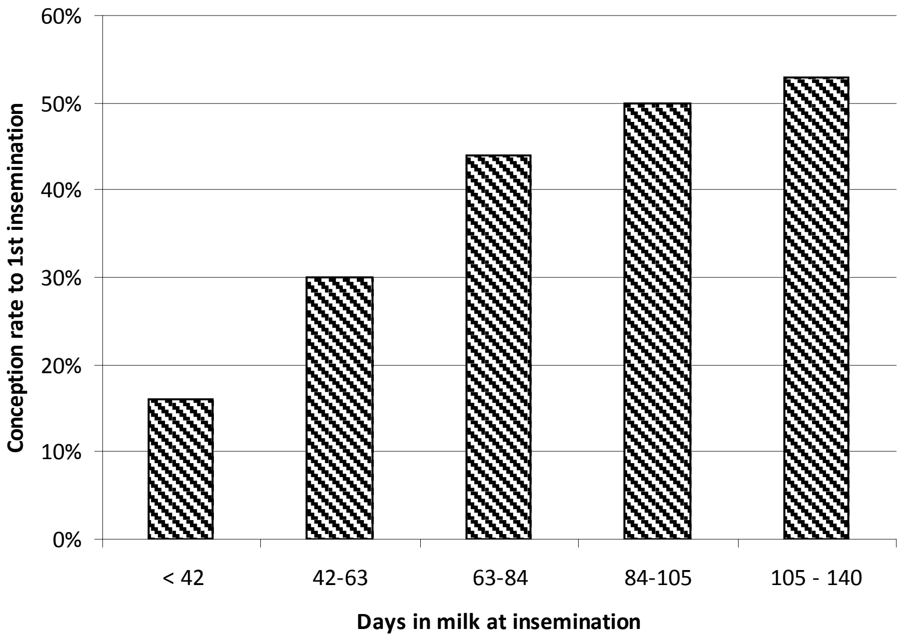


Figure 3: Effect of days in milk at insemination on conception rate in cows inseminated as part of the sexed semen field trial.

Scenarios for sexed semen use

The potential benefits to a dairy farmer and the wider industry of a sexed semen product that delivers a 90% gender bias with minimal reductions in fertility are transformative. The direct effect of increased numbers of dairy heifer calves born in a herd using sexed semen presents the farmer with a number of options. Any breeding programme that incorporates significant quantities of sexed semen must take into account the reduced fertility of the sexed semen product and increased price per straw (approximately €30 premium) compared with conventional semen.

Herd Expansion

The abolition of EU milk quotas in 2015, coupled with the government's target of a 50% increase in national milk production by 2020 presents a real opportunity for Irish dairy farmers to expand herd size and milk output. Sexed semen may have a key role in the expansion of the Irish dairy industry.

A model was developed to examine the effects of sexed semen use on rate of herd expansion and farm profitability in Irish dairy production system. Expansion from a herd size of 100 to 300 cows was modelled over a 15 year simulation period, using either conventional or frozen-thawed sexed semen in virgin heifers for the first AI and in lactating cows for the first three weeks of the breeding season.

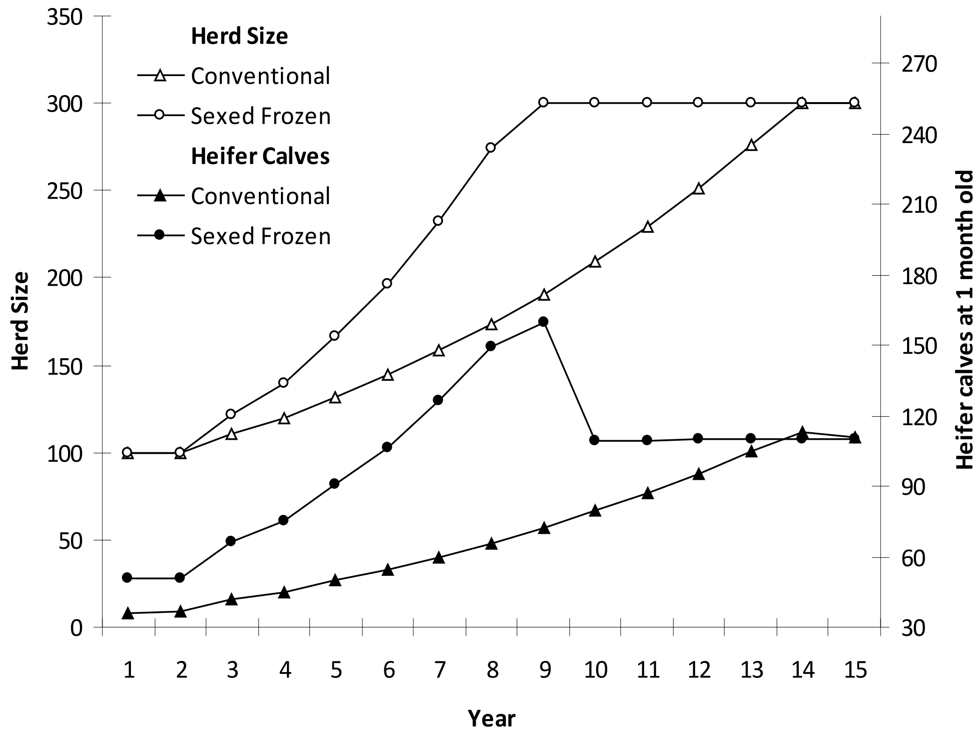


Figure 4: Herd size and number of heifer calves born in the first 6 wk of the calving period surviving to 1 mo of age in herds using sexed frozen-thawed semen or conventional frozen-thawed semen in both virgin heifers (for the 1st AI) and lactating cows (for the 1st 3-wk of the breeding season).

Using the preliminary results generated from the field trial, conception rates with frozen sexed semen were set at 87% of those achieved with conventional semen. Sexed semen use generated greater numbers of replacement heifers, and facilitated faster herd expansion (Figure 4). The faster herd expansion facilitated by sexed semen use resulted in greater levels of farm profitability over the 15-yr simulation period.

Beef production from the dairy herd

In non-expanding herds, the use of sexed semen enables the number of replacement heifers required to maintain herd size to be produced from a smaller proportion of the herd. This provides dairy farmers with the opportunity to increase revenues from the sale of calves for meat production, by breeding the remainder of the herd with semen from beef sires (short gestation, easy-calving). Current calf prices from dairy cattle suggest a premium of approximately €150 - €200 for a beef sired calf compared with a male dairy calf. The current price differential between male and female beef calves from the dairy herd does not support the use of Y-sorted (male offspring) beef semen in dairy cattle.

Heifer rearing

In order to obtain maximum lifetime milk production, all replacement heifers should be first bred at approximately 15 months of age (to calve at approximately 24 months of age). An efficient heifer rearing system is essential to meet these targets and ensure that replacement heifers optimise their potential as lactating animals. Larger, well grown heifers have greater pubertal rates at mating start date (MSD), and are more profitable over their lifetime due to superior milk production. The use of sexed semen to produce all replacement heifers in a short period at the start of the breeding season may have a significant impact on the rearing management of these heifers. These heifer calves will be closely grouped in terms of age, and should be easier to manage as one group to meet the optimal target of 60 % of mature body weight at mating start date (MSD).

Further benefits of sexed semen use

Use of sexed semen may also reduce the incidence of calving difficulty (heifer calves are lighter than male calves), and improve biosecurity by allowing farmers to increase herd size while maintaining a closed herd. A common reason for farmers not wishing to use Jersey sires in dairy cross-breeding programmes is the low value of the Jersey crossbred bull calf. Using sexed semen from Jersey bulls to generate predominantly heifer calves would eliminate this problem, increasing the attractiveness of cross-breeding programmes for a greater number of Irish dairy farmers.

Conclusions

Preliminary results of a large scale field study indicate significant improvements in the fertility of frozen sexed semen compared with previous reports, although the performance of fresh sexed semen was disappointing. Further work is required to determine the optimum conditions under which sexed semen should be used to maximise fertility performance. Best practice guidelines on the use of sexed semen will be published following the full results of the field trial in spring 2014. The use of sexed semen in Irish dairy herds has the potential to improve profitability on Irish dairy farms and add significant value to the wider agri-food industry.

Growing and utilising high levels of grass in the BMW region

Michael Magan

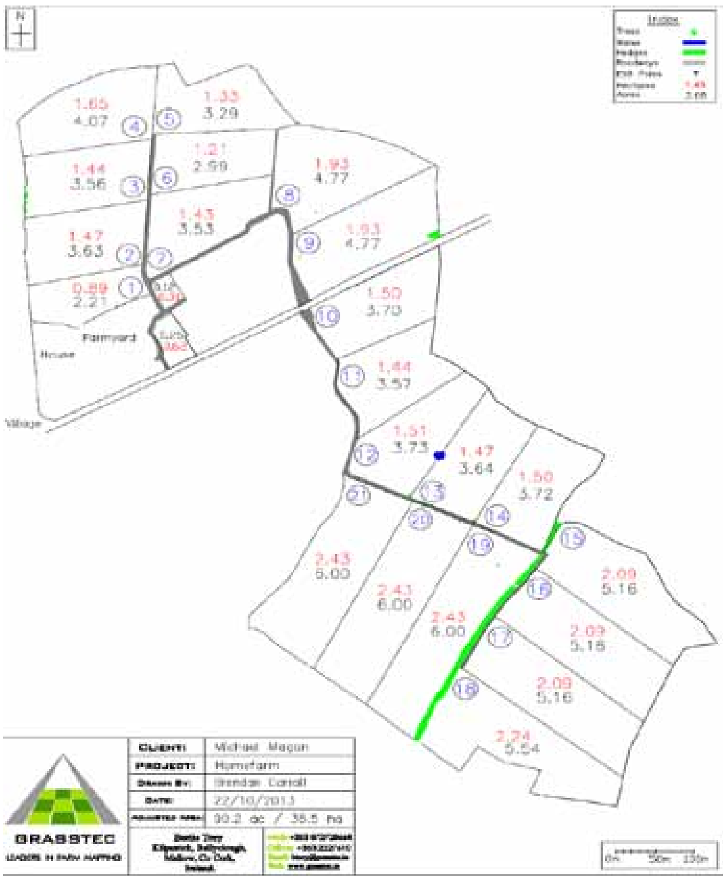
Bunacloy farm, Killashee, Co Longford.

Summary

- Currently approximately 80% of grass grown is utilised, but we need to grow more grass of a higher quality to increase utilisation.
- Investment in soil fertility is required as indicated by recent soil analysis.
- We aim to continue reseeding lower performing paddocks with monocultures that are persistent and palatable.
- Lower overall farm stocking rate by decreasing the number of replacement units reared to reduce the reliance on rented ground to supply winter feed.
- Improve overall genetics for milk solids and fertility in the herd.

Introduction

I farm in partnership with my parents in Killashee, Co. Longford. After I graduated from UCD in 2006 with a degree in Animal and Crop Production, I travelled to New Zealand and spent a season working with Synlait farms. I returned home in the summer of 2007. While in New Zealand I learned the importance of having a strategic farm plan, and the experience re-emphasised the value of grass measurement and utilisation and its effect on farm profit. I have an interest in all types of sport and I play GAA and Rugby. I am also a member of Longford Grassroots discussion group.



Bunacloy farm has a milking platform of 36.5 ha with a 26 Ha block two miles away for replacements. Further land is rented for maize and grass silage. We milk 160 spring calving Holstein Friesian cows supplying Lakeland Dairies.

The farm is located four miles east of the river Shannon and despite being surrounded by peat-lands it has a free draining mineral soil at a favourable elevation of about 40m above sea level.

The soil type doesn't dry out too much in dry conditions or get too soft in wetter times. The milking platform is split by a busy main road with approximately one third beside the parlour (used for night grazing) and the other two thirds across the road (used for day grazing).

Along with the dairy cows we rear approximately 75 replacements annually (75, 0-1 year olds and 75, 1-2 year olds).

Surplus animals are calved down and sold s milkers. Current EBI is €109 (M €44, F €45), 2013 calves have an EBI of €153 (M €57, F €69). This year we had 11.5% empty after 14 weeks breeding with all maiden heifers in calf after nine weeks. The 6 week calving rate was 57% and calving interval is 385 days. 80% of cows were calved by the end of March and the remainder calved in April.

Milk solids per cow produced was 430kgs in 2012. At a stocking rate of 4.4 cows per hectare, milk solids produced on the milking platform was 1,898 kgs per hectare.

Table 1 outlines the physical performance of the farm from 2011 to present.

Table 1: Physical farm performance for 2011-2013

Year	Cow Numbers	MP stocking rate	Solids/cow	Solids/ha milking platform
2011	156	4.27	472	2019
2012	161	4.41	430	1898
2013*	162	4.44	450	1998

* 2013 figures predicted

Grass Measurement

We have been measuring grass on the farm since 2005 and complete about 40 farm walks per year. The aim of grass measurement on the farm is to implement a grazing management plan to maximise profitability. It is my view that this plan should be practical and flexible. The aim of grass measurement for me is to optimise both plant and animal performance. The cows' nutrition is ultimately the driver of performance with the cheapest form of feed being grazed grass. As we farm at a high stocking rate, we need to be able to operate a system in which supplements are carefully integrated (in quality, timing and cost) with the farms supply of grass. This approach should be taken by all dairy farmers not just those on higher stocking rates.

I walk the farm once per week (usually on Monday) to assess the supply of grass for the coming week. I can act on the information gathered and make decisions for the week ahead regarding the level of supplementation required or if surplus grass can be removed as baled silage. Decisions are based on the supply of grass on the farm, the growth rate for the previous week and the predicted growth for the week ahead. As I have been measuring grass for a number of years I can make such decisions with confidence as I know what our farm is capable of growing under different conditions.

Walking the farm is only one part of the equation. This information has to be processed some how and since spring 2013 I have been using PastureBaseIreland to do this, previously we used the Teagasc Excel based programme. On inputting the data into PastureBaseIreland I get a figure for overall farm cover, cover per cow and growth rate for the past 7 days. PastureBaseIreland is a web based application and allows me to benchmark my farm against other farms (commercial and research). This is a useful addition to the grass measurement programme as the older MS Excel programme did not allow this.

As our cows are Holstein in nature I allocate 19kg DM intake per day. As outlined by the research carried out by Teagasc Moorepark, I adjust my grass cover targets depending on the time of year. I follow the guidelines given for the different seasons and I adjust as I see fit for my own situation.

Autumn Management

The starting point for my grazing year is the final rotation in autumn. This ensures there is a supply of grass available in the spring time for freshly calved cows. Remembering that 60% of the grass that is available in the spring time is grown the previous October it is vital that I achieve my autumn targets. I commence the last rotation around October 10th. The aim is to have 60% grazed by the end of October. On our farm this equates to 21 ha and I have 21 days to graze it, so approximately 1ha per day until the end of October. Once we hit the start of November cows are generally housed at night and are housed fully by the end of the month. This leaves approximately 0.5 ha per day for November. At this stage some culls / empty cows will have been sold to reduce demand.

Spring Management

In spring, I follow the Spring Rotation Planner, which ensures I do not finish the first rotation too early. I also do weekly farm covers at this stage to monitor farm cover and growth rates. I aim to have ⅓ grazed by March 1st, ⅔ by March 17th, with the remainder by April 5th. The amount of grass available determines the buffer feeding required. This year cows were buffer fed with maize silage from when they went to grass in early February. At such a high demand it is not possible to feed calved cows fully on grazed grass hence approximately 8ha of maize are grown annually. Maximum concentrate feeding is 5kgs per cow in the spring and normally 3-4kgs are fed during the first round. The calving season starts at the end of January. This year cows went to grass by day on February 6th and were out by night on February 22nd.

Main grazing season

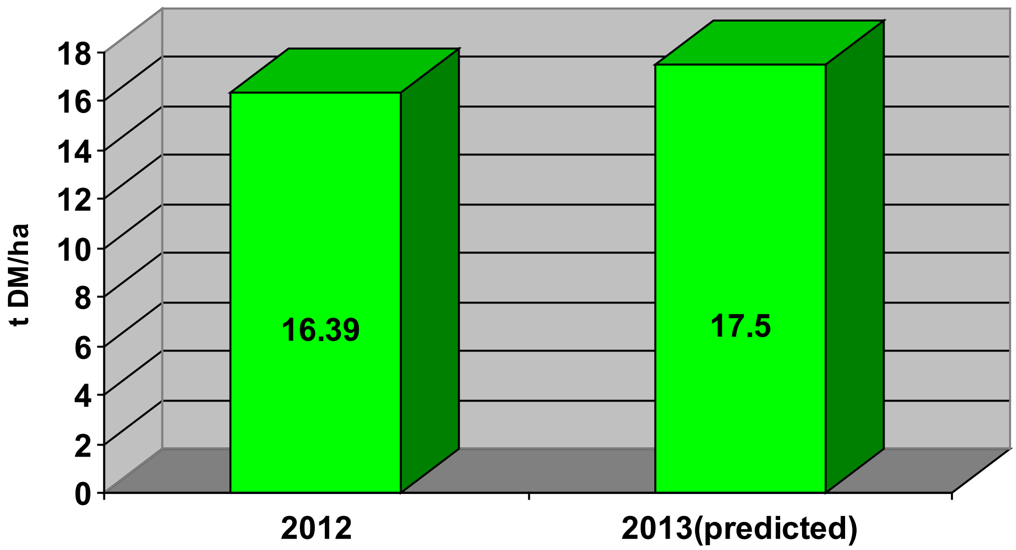
For the main grazing season my decisions are based on the grass wedge, cover per cow and growth rate. The fact that I have several years data for my own farm cannot be underestimated when it comes to giving me confidence that I am making the right decisions. Cover per cow is normally between 130-170kgs per cow during the main season. This year I managed to remove 100 round bales and 140 tonnes pit silage as surpluses from the grazing platform. Cover per cow and pre grazing yield are used to determine when surpluses are removed or when extra supplementation is required. In my view feed supply is comfortable at between 160-180 kg DM/cow. Normally 2kg meals are fed through the summer. To the end of October this year 701 kg concentrate have been fed per cow.

From August onwards my focus shifts more to average farm cover (AFC) rather than cover per cow. I do this as I need to build grass covers for the Autumn period. For me it meant feeding silage (most of the 100 bales harvested during the year) for most of the month of September this year. Grazing conditions were excellent and growth was exceptionally high but supplementation was necessary in order to build covers on the farm due to our high stocking rate. This year cover peaked at approximately 1200 kg DM/ha (270 Kg DM per cow).

Performance

Our farm is capable of growing a lot of grass as outlined in Figure 1. Average growth for the past four years is 17.7 t DM/ha. I predict that total growth for 2013 will be 17.5 t DM /ha.

Figure 1: Total grass growth 2012 and predicted for 2013

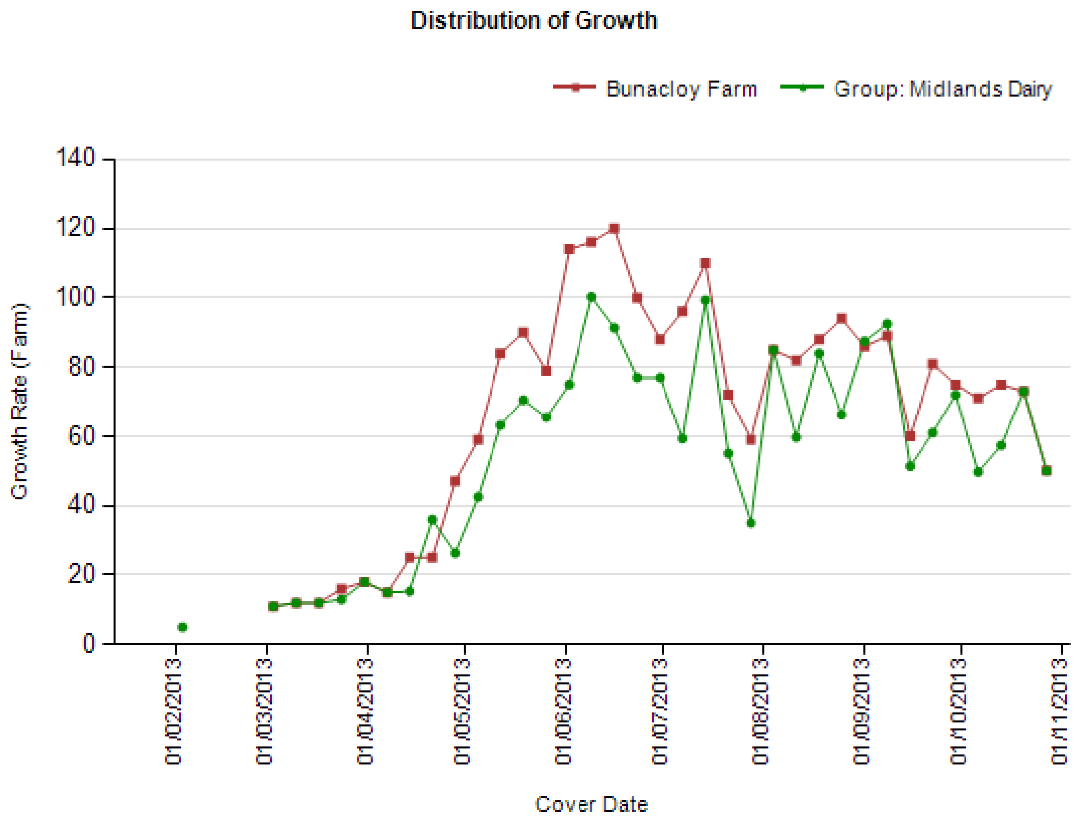


Growing all this grass is one thing but utilising it is really the main challenge. Using the Grass Utilisation Calculator we estimate that grass utilised for our farm for 2013 will be 14 t DM/ha. This is 80% of grass grown. I would like to increase this to 85%. I believe this will be achieved by reseeding the remaining 30% of the farm over the next number of years and replacing older grasses with newer varieties which are more palatable and easier to utilise.

The distribution of grass growth for 2013 is outlined in Figure 2. This graph is taken directly from PastureBaseIreland. It also illustrates the growth differential between our farm and other dairy farms in the midlands region using the system. It is interesting to note that our growth curve is similar to other farms in the region but is consistently about 20% higher for most of the season. I find that this is a very useful element to PastureBaseIreland – the fact that I can benchmark our farm against others in the region. As all the Teagasc research farms use PastureBaseIreland, I can also benchmark our farm against those, in particular the Ballyhaise farm.

From Figure 2 you can see that growth on our farm was consistently over 100 Kg DM/ha in mid-summer. Growth rates for the month of September into October were between 70 and 80 Kg DM/ha/day.

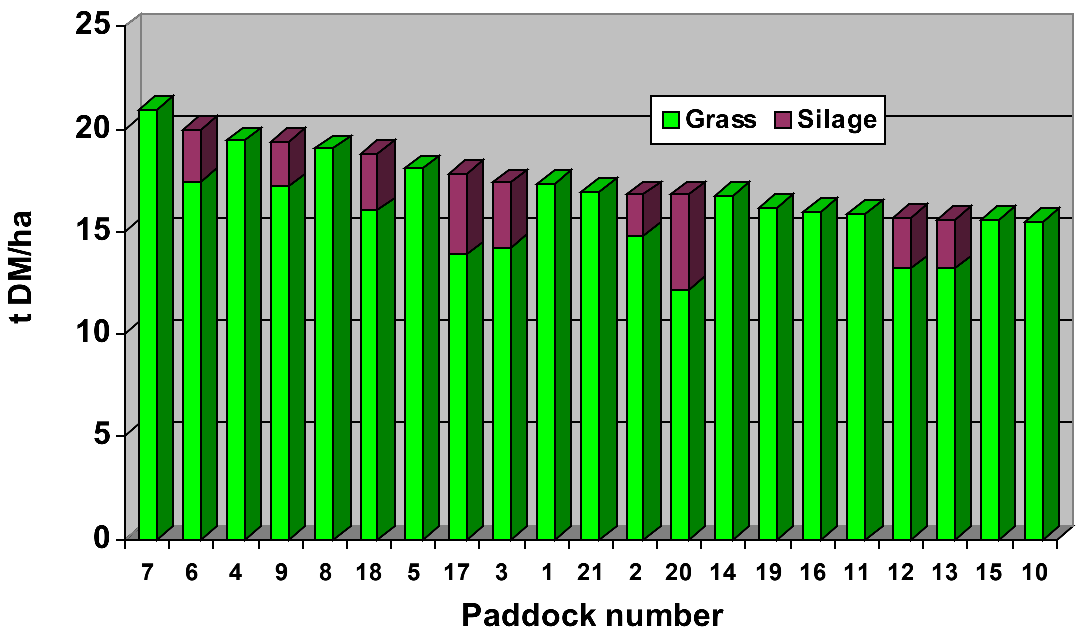
Figure 2: Distribution of growth for 2013 (Bunacloy farm vs. Midlands dairy farms)



One thing you find out fairly quickly when you start measuring grass is which paddocks need reseeding. Figure 3 shows the total grass grown per paddock to date in 2013. On the basis of this, our worst performing paddock, number 10, will be reseeded in 2014.

Reseeding on our farm is timed to coincide with first cut silage. The area is sprayed with Roundup 7-10 days before cutting the main first crop. It is then harvested and ensiled, the ground is ploughed and any farmyard manure available is applied. This usually happens at the time when growth rates are highest on our farm and thus allows us a short turnaround time of approximately 42 days. I think this is a real help to the system, bringing in a new grass sward fast and losing little DM production from the time the paddock is sprayed off to when it's growing again. Approximately 70% of the farm is reseeded to date. As previously mentioned the lowest performing paddock will be targeted for reseeding as a result of the information gathered through weekly measurement.

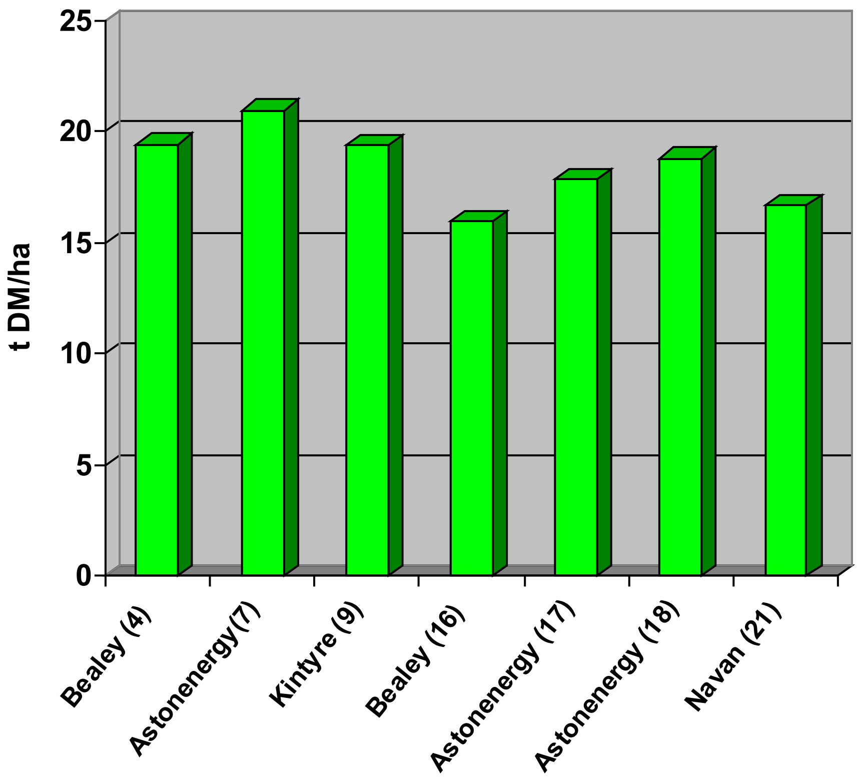
Figure 3: Distribution of paddock growth in 2013.



The 2011 soil analyses for Nitrates purposes have shown P and K deficiencies on the farm. More recently we undertook individual sampling of paddocks to get a better handle on the P and K indices. This showed that 57% of paddocks are at either index 1or 2 for P and K. Fertiliser requirements for the next number of years will be on average 28Kgs P/ha and 53kgs K/ha. If all this is applied in the form of chemical fertiliser, I estimate that it will cost €120 per ha. This cost will be reduced through the use of slurry. Average lime requirement is 2.5 t/ha over all the paddocks.

There are several monocultures on the farm. These include Bealey, Astonenergy, Navan and Kintyre. Figure 4 illustrates the growth for these monocultures in 2013. Astonenergy in paddock 7 has produced 21 t DM/ha so far this year and this is probably a monoculture we will look at using more of in the future. We have been very happy with the use of monocultures on our farm and although the advice is to include a number of varieties in a seed mix we will continue with using one. Many of our monocultures are tetraploid and we find on good free draining soils that utilisation is easier as cows do not have to graze a dense base of grass and therefore clean out paddocks easily.

Figure 4: Grass grown (t DM/ha) up to 29/10/13 for the different monocultures (paddock number in brackets)



Looking forward

PastureBaseIreland allows me to compare and contrast with other farmers who are striving for the same goal as myself. I would like to see a grass growth predictor based on previous years data included in the programme. This would allow me to predict what the wedge would look like in the weeks ahead based on a predicted growth rate. As farmers we always need to be ahead of the growth curve.

For me the target has to be to grow 20 t DM/ha over the entire farm, if one paddock can do it why not the rest? Money will have to be invested in raising the P and K levels on the farm. We will focus on improving the lower producing paddocks and establishing why they aren't performing.

Current stocking rate will be maintained on the milking platform and I hope to push milk solids per cow from the current 450 (predicted 2013) to close to 480-500Kgs per cow. I would like to compact our calving a lot more than what it presently is, I think there is an opportunity to get more milk from the herd if I can get this right. We will always be focussing more on per hectare production than per cow. I see a realistic target of 2,200 Kgs milk solids per hectare possible on the milking platform. We will focus more on fertility and milk solids in the future when selecting bulls.

Another area under review is the amount of replacement units reared on the farm. Rather than rearing all heifer calves we are considering carrying 40 units to adequately cover replacement rate for our own herd. This will decrease overall farm stocking rate and allow more forage conservation from owned land thereby reducing the requirement for land rental.

Other than growing and utilising more grass on the farm, a further priority is a new milking parlour in the near future. Further down the line an overpass to link the two blocks of land that make up the milking platform will be considered.

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