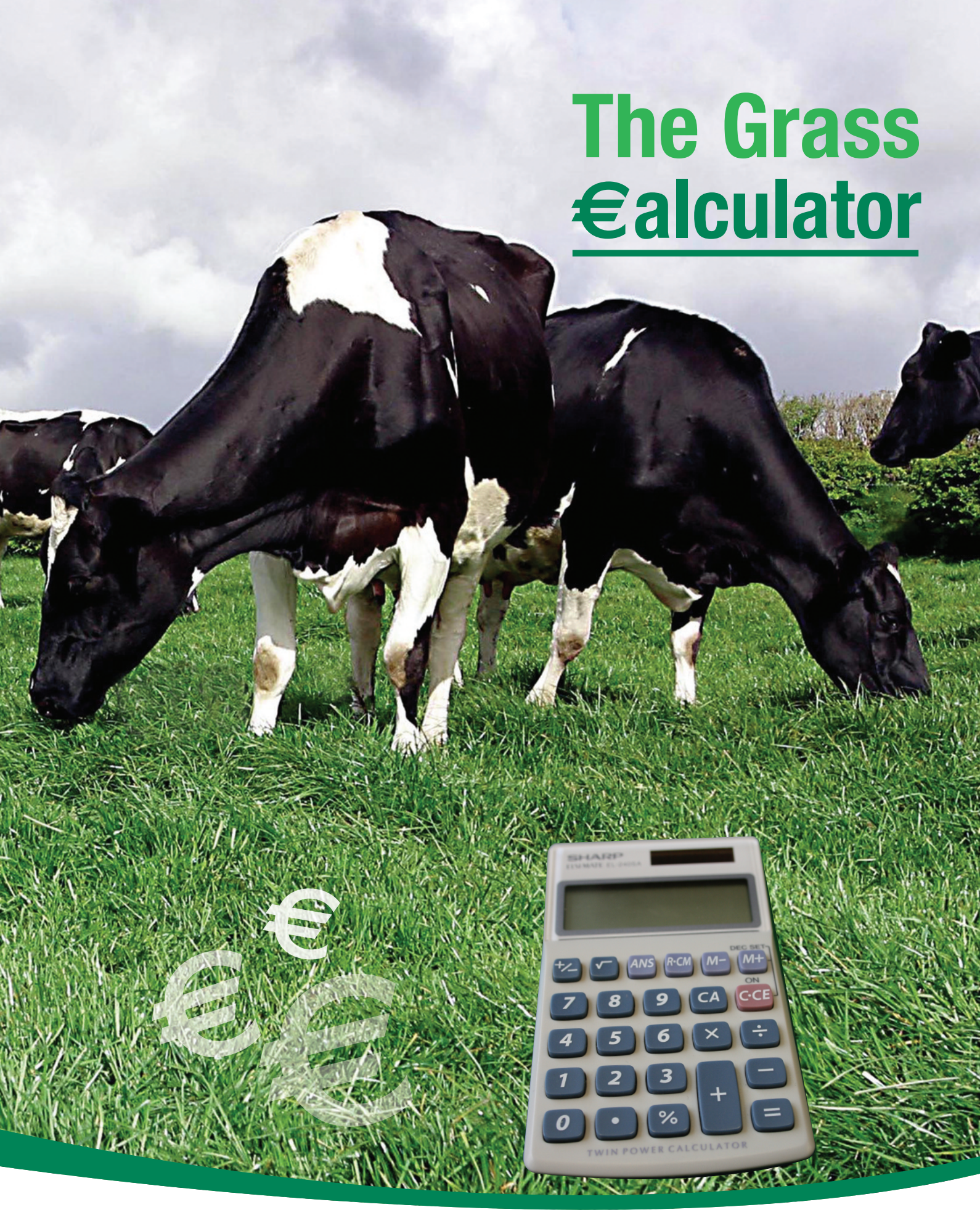
The Grass €alculator



teagasc
Agriculture and Food Development Authority

Ulster Bank

The Grass €alculator

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'The Grass €alculator' can be downloaded from the Teagasc website at:
www.agresearch.teagasc.ie/moorepark/

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The Grass Calculator

High profit pasture based dairy farming requires high levels of milk solids productivity from grass. Home grown feed production and utilisation is likely to be the main long term limitation to profitable milk production once milk quotas are removed. Profitable dairy farming within grazing systems is strongly linked to the amount of grass that is harvested per hectare and together with supplementary feed, how efficiently that grass is converted into saleable product, in the form of milk solids. Figure 1 below shows that 44 per cent of the variation in profit per hectare between farms in 2008 was explained by the amount of grass utilised on the farm (Shalloo, 2009). 'The Grass Calculator' has been developed to provide the Irish dairy industry with a scientifically robust method of calculating the quantity of grass harvested on-farm annually (tonnes DM/ ha) as an aid to decision making.

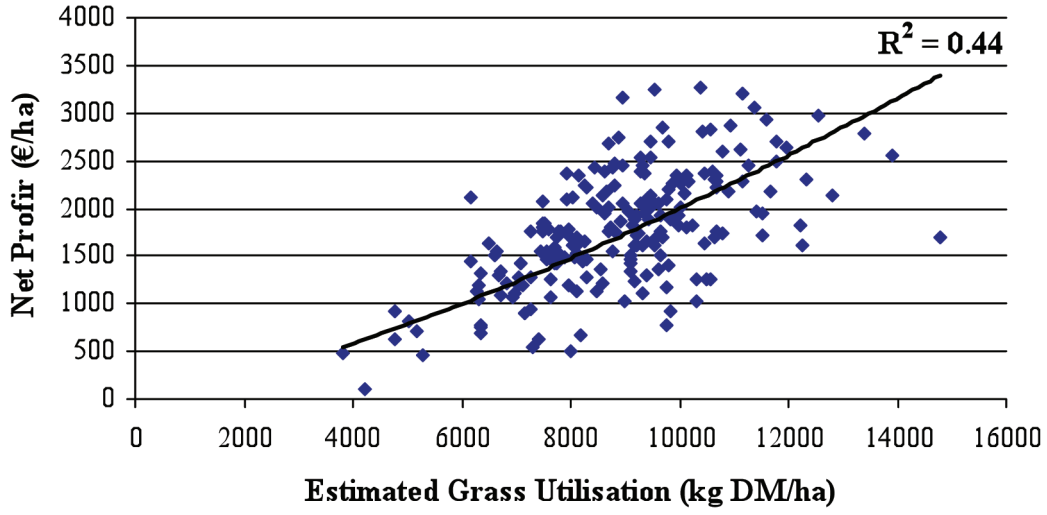


Figure 1. The relationship between estimated grass utilised per hectare and net profit per hectare (Shalloo, 2009)

Recommendation for all dairy farmers

- Grass harvested per hectare (tonnes DM/ha) from the milking platform and from the whole farm area are essential measures of successful grazing systems and should be calculated annually for every dairy herd.
- As the availability of home grown feed will be the primary limitation to profitable farm business expansion, feed conversion efficiency (FCE; kg milksolids produced per tonne DM) should increasingly preoccupy dairy farmers thoughts when developing their systems for the future.
- As grass utilisation is closely linked to profitability, 'The Grass Calculator' should be used in conjunction with the annual financial results to inform farm decision making on grazing and supplementation management policy as well as AI sire selection (genetic characteristics) in conjunction with the Economic Breeding Index (EBI).

The Grass Calculator - key points:

- On completion of the end of year physical and financial accounts, 'The Grass Calculator' can be used to identify opportunities to increase grass utilisation and farm profitability in future years.

- The calculator uses the energy requirements for cows (and other stock) of known liveweight and production to calculate feed requirements and estimates the quantity of grass harvested by deducting from these requirements the energy supplied to the system from external supplements. The estimate of home grown feed harvested may relate to the total area of the farm or to the milking area (grazed by the milking herd).

- The calculator uses equations based on 'A Net Energy System for Cattle and Sheep' (O' Mara, 1998) to calculate the net energy (NE) requirements of all stock grazing on the farm. These feeding standards take into account the NE requirements associated with grazing dairy cows (maintenance, lactation and pregnancy) as well as those for growth of young stock and for condition score change.

- The calculator uses inputs that describe the farm animals, supplements and data on milk production, all of which are easily available to farmers.

- The calculator uses a 'back-calculation' approach whereby animal NE requirements, less 'estimates of the NE supplied by consumed supplementary feeds' is equal to the NE supplied by grass consumed on the farm.

Introduction

As a consequence of Ireland's natural competitive advantage in food production from grazed grass, the recent 'Food Harvest 2020' report anticipates a 50 per cent expansion in dairy production. In the next decade, fewer dairy farmers with increased operational scale will leverage increased productivity and profitability from grass based systems fueled by leading edge management technologies. Every dairy farm business must use the intervening years to quota abolition to develop their farming operations in a manner consistent with the requirements of a vibrant and expanding industry for the future.

In all dairy systems the quantity and quality of feeds used, and the efficiency with which those feeds are converted into saleable product in the form of milk solids, have a major impact on the success of the system. The principle of maximising output per unit of input is vital to ensure a high level of overall productivity. In contrast to confinement systems, grazing dairy systems have lower costs of production, while overall profitability depends on maximising the amount of grass grown, harvested and, together with any supplementary feeds, converted into milk by grazing dairy cows. The relationships between the main factors influencing productivity within grazing dairy systems are illustrated in Figure 2 and include stocking rate, calving date and pattern, dairy cow breed and genetic merit, herd health and fertility and age structure. Despite its importance, the total amount of feed in the grazing system has proved difficult to quantify for most farmers, due to the difficulty in measuring the quantity of grass grown and eaten. Consequently, 'The Grass Calculator' has been developed to provide the Irish dairy industry with a scientifically robust method for calculating the quantity of grass harvested (tonnes (t) DM/ha) on-farm annually.

Profitable dairy farming within grazing systems is strongly linked to the amount of grass harvested per hectare and, together with supplementary feed, how efficiently that grass is converted into milk. As can be seen from Figure 1, the amount of grass harvested per hectare explained 44 per cent of the variation in net profit per hectare between farms in 2008 (Shalloo, 2009). Dairy farmers are now well aware that feeding large amounts of supplements to grazing dairy cows generally reduces overall farm profitability. To improve farm productivity and profitability farmers need to understand how much feed (both grass and supplementary feeds) is being consumed on farm, and then examine the opportunities to use that feed more efficiently to increase milk production. While weekly grass supply measurement during the grazing season is recommended to ensure synchrony between grass supply and demand, estimating the amount of grass consumed on farms can be difficult. 'The Grass Calculator' uses a 'back-calculation' technique (based on energy requirements and farm inputs) to provide an estimate of farm feed utilisation in terms of the quantity of grass harvested per hectare, which will help farmers to understand how much feed they are producing and using on their farms.

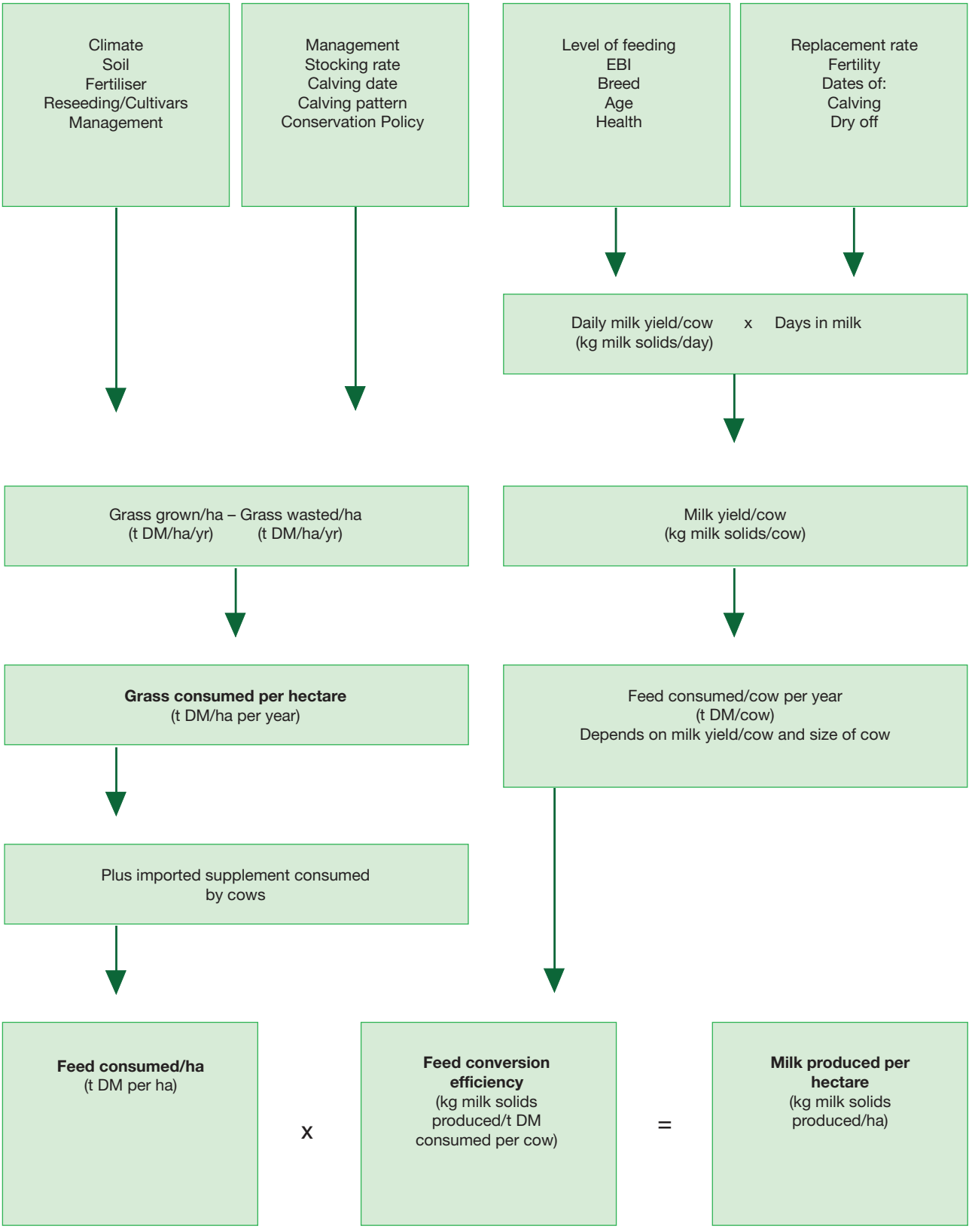


Figure 2. The main components of productivity per hectare in grass-based milk production systems (adapted from Holmes, 2008)

Factors influencing Grass Utilisation and Milk Production

As can be seen from Figure 2, there are a large number of factors that influence the amount of grass utilised and the subsequent milk production achieved. The most important of these factors from a farm management perspective are stocking rate, calving date and pattern and supplementation. How these factors interact with each other and with the feed conversion efficiency (FCE) of the herd will determine the amount of milk produced.

Stocking rate

As shown in Figure 2, the amount of grass grown depends on a number of climatic, soil and management factors. As much of this grass as possible, should be harvested by the grazing cow. Striking a balance between the amount of grass grown and herd demand for that grass is the key to maximise productivity within grazing systems. Stocking rate (expressed as the number of livestock units (LU) per hectare (LU/ha)) has a major effect on the amount of grass harvested per hectare, levels of milk solids production per hectare and the overall productivity of the farm. If the stocking rate is too high then cows will be underfed and their production will be reduced. If the stocking rate is too low then grass is wasted because it is not eaten by the herd. In both Irish and international studies of grazing systems, increasing stocking rate has been observed as the main method to increase productivity from grassland with the extra product realised through increased grass utilisation, i.e. the amount of grass harvested per hectare. The optimum stocking rate is one where a balance is found between the amount of feed grown and utilised on the farm, the quality of that feed and the feed requirements of the herd (Shalloo, 2009).

Calving date

In seasonal grazing dairy systems, the planned start of calving, the calving pattern and the mean calving date are critical in terms of matching feed supply and herd feed demand in early spring. The correct planned start of calving is vital to maximise grass utilisation and profitability (Clark *et al*., 2009). Calving should be concentrated just before the start of the grass growing season to ensure that synchrony is achieved between feed supply and demand. Calving too early, in particular at higher stocking rates, will lead to underfeeding of the herd or will result in substantially increased supplementary feeding as grass growth rates are unable to match herd demand. The mean calving date and calving pattern will also impact grass utilisation. A spread out calving pattern will cause a slippage in mean calving date and can reduce grass utilisation. In general, the herd should be calved as early as possible, provided that it can be fed adequately from a predominantly grazed grass diet throughout early lactation. At any given stocking rate, the correct calving date will maximise animal performance by increasing the length of lactation as well as having a high level of production per day of lactation. Matching herd demand to grass growth in spring through the correct timing and pattern of calving will also facilitate increased grass utilisation and will create the ideal demand for a predominantly grazing diet with little need for expensive supplements.

Supplementation

When supplements (either concentrate or forage) are fed to grazing dairy cows, the intake of grass is usually reduced and the overall effect of increasing feed supply by feeding supplements is often conflicting (Holmes, 2008). The economic impact of supplementation depends on the price of milk, the cost of the supplement and the management practices at the time of supplementation. Supplementation increases milk solids production, however, grass utilisation will be reduced, whilst the effect on overall farm profitability is variable. The reduction in grass intake caused by supplementation is called substitution, as the supplement is replacing or substituting for grass in the cow's diet. The variability in the effects of supplementation depends on many factors such as the type of cow, grass availability, weather conditions and the type and level of supplementary feeding. The use of supplements adds a degree of flexibility to the feeding management of the herd on occasions when grass supply is inadequate. It will reduce the animals' requirement for grass and buffers animal intake in times of feed deficit. Supplementation can therefore be an efficient short term management strategy to overcome feed shortages while maintaining herd performance when grass supply is in a deficit situation. Evidence from National Farm Survey statistics suggests that supplementation is commonly used on Irish dairy farms to increase individual animal production rather than to provide a short term feed buffer where grass is in short supply. Research studies clearly demonstrate that where grass supply is adequate and the herd is receiving an adequate provision of grass, introducing supplements tends to increase milk production per cow but substantially reduces the grass intake of the herd. In this scenario, high cost supplement mainly replaces relatively cheap grazed grass in the animal diet, reduces grass utilisation, increases workload and management complications for the farmer and substantially reduces overall farm system profitability.

Negative associative effect of concentrate

When supplementary concentrates are fed to grazing dairy cows, the digestibility of the total diet may be reduced causing the energy value of the diet to be less than the sum of the individual components. This is called a 'negative associative effect'. Basically, the energy available from the supplementary concentrate is less than expected because of the negative effect associated with feeding concentrate with grass. This is most common when highly fermentable starch containing supplements are fed with fresh grass or silage.

Feed Conversion Efficiency

Feed conversion efficiency is a measure of the ability of a cow to convert feed into milk and can be expressed as kg milk solids produced per t DM consumed per cow. It is dependant on the milk production and maintenance requirements of the individual cow, both of which are affected by the genetic characteristics of the cow (EBI), the fertility status of the herd, condition score change within the herd and the culling and replacement policies on the farm. The FCE of a cow will increase if she produces more milk solids per tonne of feed eaten. Smaller cows with higher yields are most efficient, while larger cows with lower yields are most inefficient. Ultimately, the FCE of the herd (or the farm) is mainly dependant on achieving an appropriate stocking rate and calving date for the herd on the grazing area with best practice grazing management, with other factors such as the characteristics of the individual animals of lesser importance.

Understanding the Energy Pathways of Grazing Systems

Within grazing dairy systems, energy is the key limitation to increased animal productivity from grass. Energy is required for a number of physiological processes including maintenance, pregnancy, activity, milk production and growth. As the energy supplied in the diet is used differently for these various processes, information relating to each process is required to accurately calculate total energy requirements for the herd. For example, the energy required for maintenance is estimated from the liveweight of the cow. Therefore, the energy required for maintenance will be greater for a 600 kg cow compared to that required for a 500 kg cow. Cows also require energy for activities such as walking and grazing, which are calculated as a proportion of maintenance requirements. Cows that are indoors have a lower maintenance requirement than cows outdoors and larger cows require more energy for walking and grazing than smaller cows. Similarly, the energy required for milk production depends on the composition of the milk, especially the fat content of the milk. Consequently, milk produced with higher fat and protein contents requires greater amounts of energy per litre than lower composition milk and so both the volume and composition of the milk must be known. Energy is also required for pregnancy and for growth by younger animals, to enable them to reach their mature size. Body condition score (BCS) change also has an energy effect with a net increase in energy requirements to replace the BCS lost. To estimate feed requirements within grazing systems, the energy required for all of these processes must be considered.

'The Grass Calculator' calculates the net energy (NE) in units of feed for lactation (UFL) for the physiological processes involved in milk production based on equations published in 'A Net Energy System for Cattle and Sheep' (O'Mara, 1998). Figure 3 is a representation of the pathways through which energy is required in grazing systems and illustrates how these processes are incorporated within 'The Grass Calculator' to estimate the amount of grass harvested per hectare. The calculator uses a 'back calculation' approach based on accurate descriptions of the number of animals grazing the area under consideration and milk production data. Estimates of the energy supplied by imported supplementary concentrate and forages are also calculated. When the amount of energy supplied by supplementary feeds imported to the farm and the herd energy requirements are known, the amount of energy that remains must have come from grass on farm and can be calculated by subtraction. The estimate of energy provided from grazed grass is converted to tonnes of DM of UFL equivalent. This represents the total amount of grass harvested on the farm, while the total figure divided by the area under consideration provides an estimate of the amount of grass harvested per hectare on the farm.

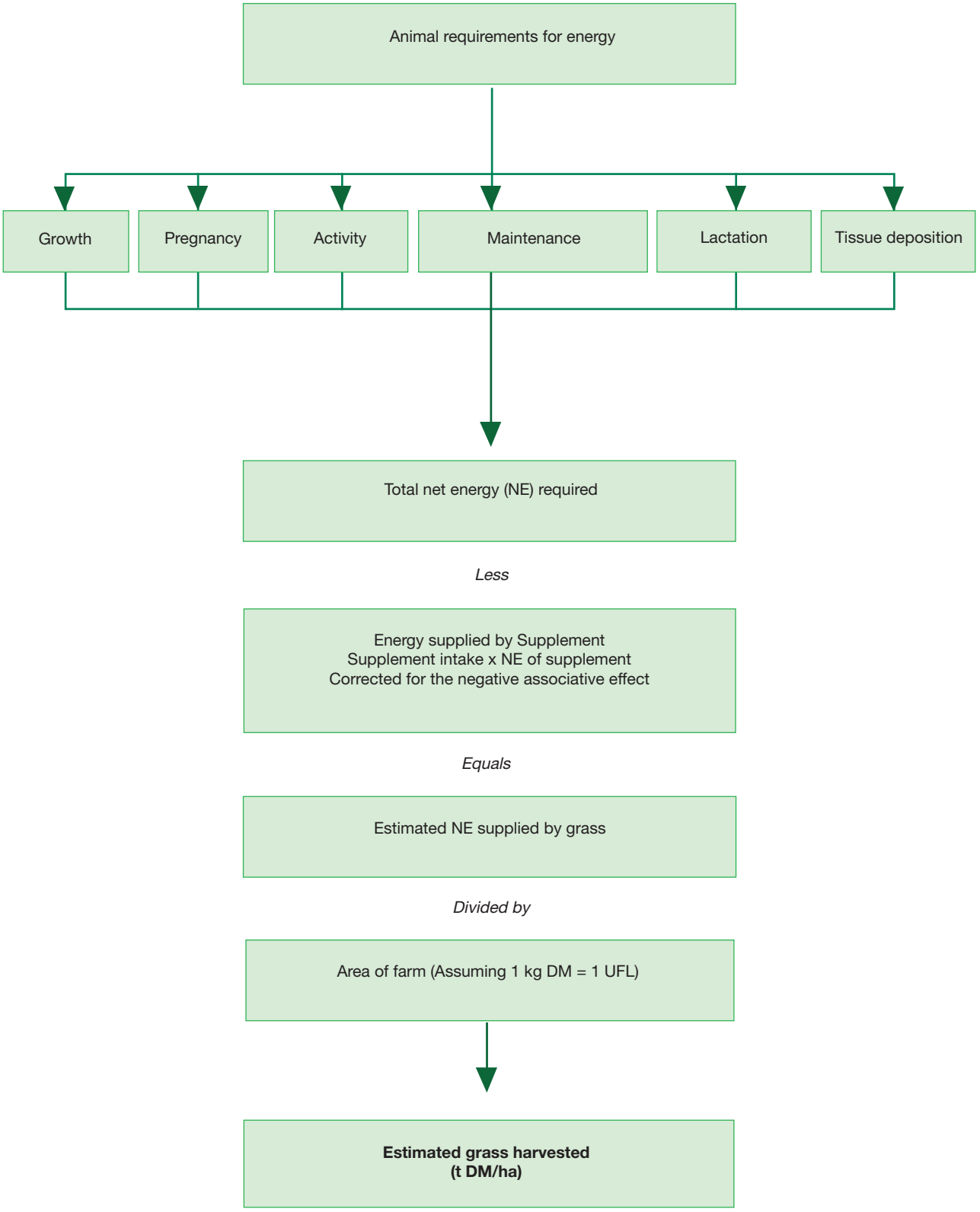


Figure 3. The energy requirements for grazing dairy cows and calculations used to estimate the grass harvested within "The Grass Calculator".

How the calculator works
Opening sheet

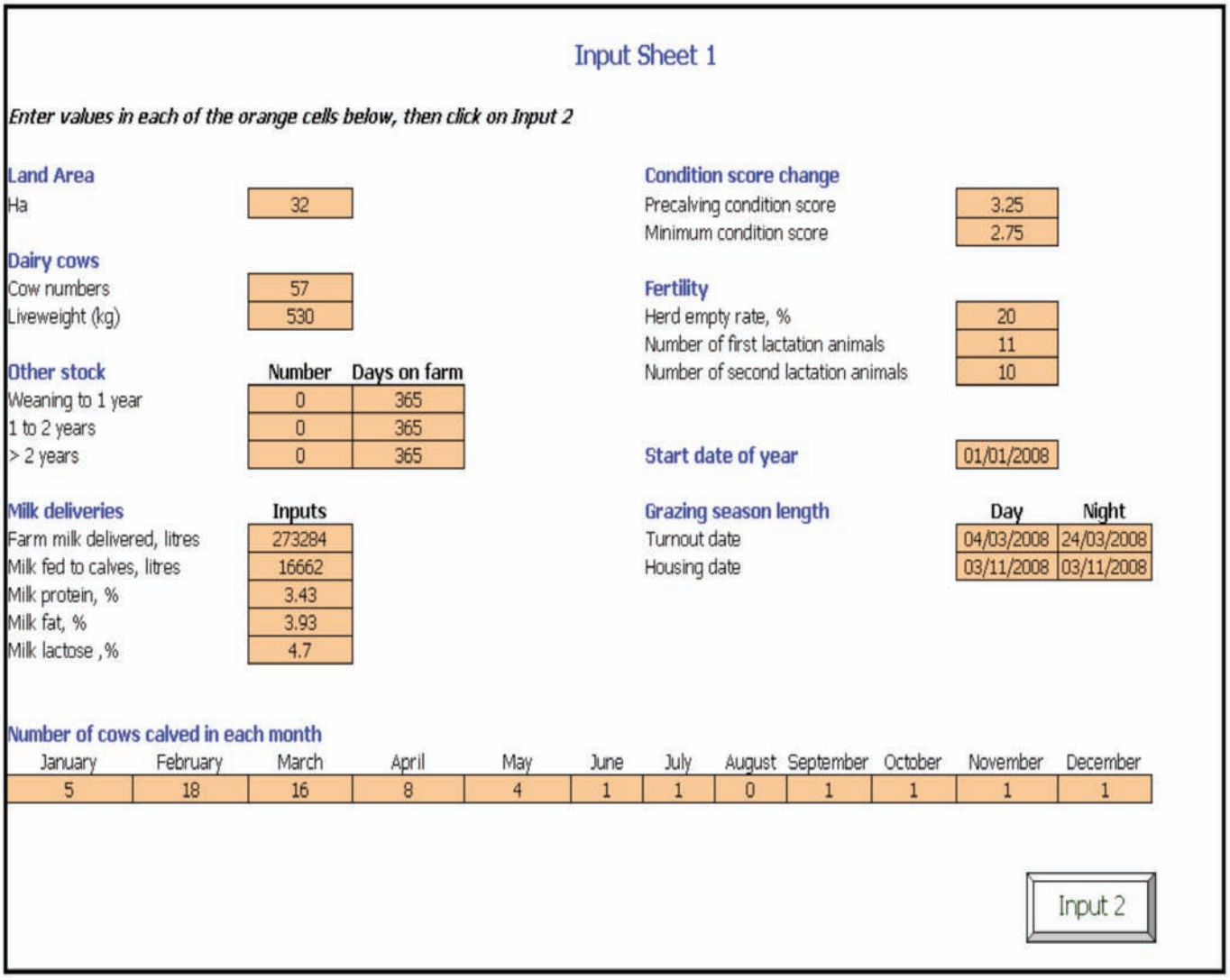
Figure 4. Opening sheet of 'The Grass Calculator'

This is the first sheet users will see when they open the 'The Grass Calculator'.

Start: This button will start the calculator by opening the first input sheet of the calculator.

Reset: This button will reset the calculator to its default mode by clearing any information that has been entered into the calculator allowing the user to start again.

Input Sheet 1
Animals and Milk production



Input Sheet 1

Enter values in each of the orange cells below, then click on Input 2

Land Area

Ha	32

Dairy cows

Cow numbers	57
Liveweight (kg)	530

Other stock

	Number	Days on farm
Weaning to 1 year	0	365
1 to 2 years	0	365
> 2 years	0	365

Milk deliveries

	Inputs
Farm milk delivered, litres	273284
Milk fed to calves, litres	16662
Milk protein, %	3.43
Milk fat, %	3.93
Milk lactose ,%	4.7

Condition score change

Precalving condition score	3.25
Minimum condition score	2.75

Fertility

Herd empty rate, %	20
Number of first lactation animals	11
Number of second lactation animals	10

Start date of year 01/01/2008

Grazing season length

	Day	Night
Turnout date	04/03/2008	24/03/2008
Housing date	03/11/2008	03/11/2008

Number of cows calved in each month

January	February	March	April	May	June	July	August	September	October	November	December
5	18	16	8	4	1	1	0	1	1	1	1

Input 2

Figure 5. Input sheet 1 of 'The Grass Calculator' – milk and animal inputs.

Land area

This can be the total area of the farm or just the area of the milking platform. If only the milking platform is entered and not all of the winter feed is produced on the milking platform then care must be taken to enter the amount of silage that was brought in from out farms, purchased, etc., in input sheet 2. In order to accurately estimate grass harvested, if forage crops are grown on the area under consideration, then the area under the forage crop must be deducted from the area under consideration. The amount of feed produced by the forage crop should then be entered as a supplementary feed in input sheet 2.

Dairy cows

Cow numbers: The number of cows that were milking in the herd during the year should be entered here as accurately as possible. If some cows were not milked for their full lactation or if cows were sold during the year then an average figure should be included for cows on the farm. If cows leave the area under consideration for the winter or winter feed is bought in the form of concentrate or forage, including forage crops, an estimate of the amount of feed brought in should be entered into input sheet 2.

Liveweight: A liveweight of 530 kg is taken as the average liveweight of a dairy cow during the year, which can be used if the liveweight of the cows on the user's farm is unknown. A list of cow breeds and average liveweight for each breed is also given so users can decide which breed best matches the cows on their own farm and can then enter the appropriate liveweight according to the breed of cow on their own farm. However, if the average mid lactation liveweight of the cows is known by the user then this should be entered here. The average liveweight of the cows in the herd should be entered as accurately as possible to ensure that maintenance requirements for the herd are estimated correctly. Over or under estimation of cow liveweight will lead to an inaccurate estimation of grass harvested.

Other stock: If stock other than milking cows (e.g. replacement heifers, dry cows etc.) graze on the area under consideration (farm or milking platform) then they must be included in the energy requirements of the farm. There are three categories of stock which can be entered 'weaning to 1 year', '1 to 2 years' and 'older than 2 years'. Cull cows should be entered in the over 2 years category. The number of each of these stock and the amount of time (in days) these stock were on the area under consideration must be entered. The calculator takes into account that the different types of stock have different requirements for maintenance and growth.

Milk deliveries

Farm milk delivered (Litres): Entered from farm delivery/production records.

Milk fed to calves (Litres): Should also be entered as this milk was produced by the cows on the farm and to leave it out would result in the under estimation of grass harvested. On average, calves are fed between four to five litres per day of milk up until the time they are weaned. An estimate of the milk fed to calves can be obtained by multiplying the average number of calves by the length of time from calving to weaning (in days) by four or five litres per day.

Milk fat, protein and lactose percent: The energy required for milk production depends on the composition of the milk. More energy is required for milk with higher fat, protein and lactose contents. The fat and protein percentages should be entered here. A default figure of 4.70 per cent is included for lactose. However if the actual lactose percentage of the milk produced on the farm is known then this should be entered here.

Condition score change: The average BCS at calving and the minimum BCS during lactation should be entered here in order to calculate the NE required for tissue mobilisation and deposition. An average calving BCS of 3.25 is given as a default figure while an average minimum BCS of 2.75 is also given as a default. If the actual BCS at calving and actual minimum BCS are known then they should be entered here.

Fertility: The herd empty rate is also entered to take into account the fact that cows that are not pregnant do not require energy for pregnancy. Thus, energy requirements for pregnancy are only calculated on the number of cows that are actually pregnant. The number of 1st and 2nd lactation cows in the herd is also required. Cows at the start of their 1st lactation weigh less than mature cows and research has shown that these animals gain weight during their 1st and 2nd lactations to reach their mature size. The energy required for this growth is calculated in the calculator. An empty rate of 20 per cent is taken as the default figure, with the number of 1st and 2nd lactation animals calculated based on this figure. Again if the numbers of 1st and 2nd lactation animals are known they should be entered here. If the herd empty rate is known, it should also be entered here.

Start date of year: This is the first day of the year in question, for example 01/01/2011. This should always be set at the first day of the year in question.

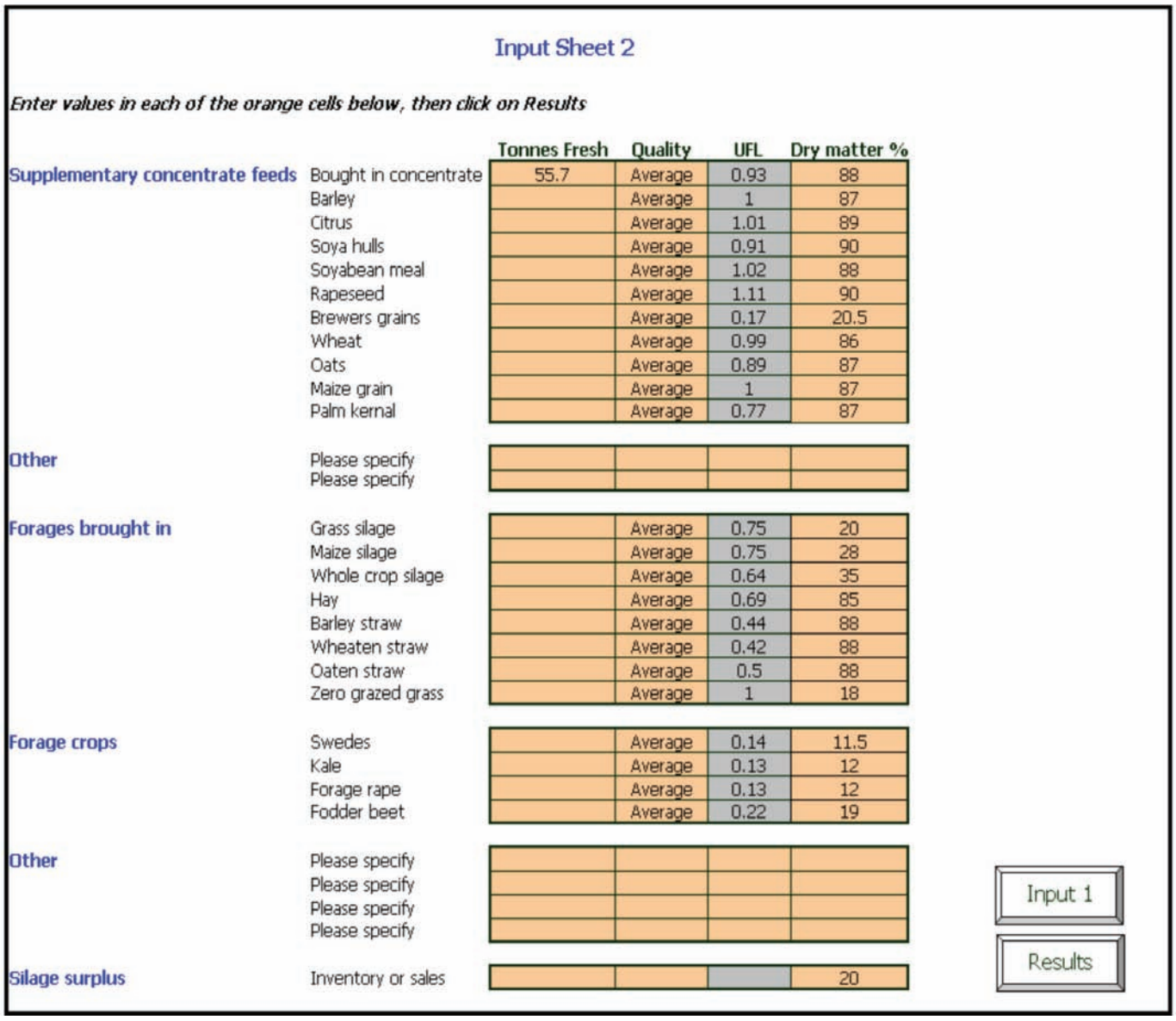
Grazing season length: To facilitate the accurate calculation of the grazing season length, the date cows were turned out to grass by day only and then by day and night should be entered here. The date cows were housed by night only and then housed fulltime should also be entered here.

The number of cows calved in each month: In order to calculate the percentage of cows calved at turnout and its interaction with grazing season length, the number of cows calved in each month should be entered. A calving pattern of 10, 40, 25, 15 and 10 per cent calving in January, February, March, April and May, respectively, is set as a default calving pattern and using the total number of cows, the number of cows calved in each month is calculated. However, if the number of cows calved in each month is known then it should be entered for each month.

Input 2: This button will bring users to input sheet 2, the supplementary feed sheet.

When all the details in this screen have been entered, users should select the Input 2 button.

Input Sheet 2
Supplementary Feeds



Input Sheet 2

Enter values in each of the orange cells below, then click on Results

		Tonnes Fresh	Quality	UFL	Dry matter %
Supplementary concentrate feeds	Bought in concentrate	55.7	Average	0.93	88
	Barley		Average	1	87
	Citrus		Average	1.01	89
	Soya hulls		Average	0.91	90
	Soyabean meal		Average	1.02	88
	Rapeseed		Average	1.11	90
	Brewers grains		Average	0.17	20.5
	Wheat		Average	0.99	86
	Oats		Average	0.89	87
	Maize grain		Average	1	87
	Palm kernal		Average	0.77	87
Other	Please specify				
	Please specify				
Forages brought in	Grass silage		Average	0.75	20
	Maize silage		Average	0.75	28
	Whole crop silage		Average	0.64	35
	Hay		Average	0.69	85
	Barley straw		Average	0.44	88
	Wheaten straw		Average	0.42	88
	Oaten straw		Average	0.5	88
	Zero grazed grass		Average	1	18
Forage crops	Swedes		Average	0.14	11.5
	Kale		Average	0.13	12
	Forage rape		Average	0.13	12
	Fodder beet		Average	0.22	19
Other	Please specify				
	Please specify				
	Please specify				
	Please specify				
Silage surplus	Inventory or sales				20

Input 1

Results

Figure 6. Input sheet 2 of 'The Grass Calculator' – supplementary feed inputs

Supplement categories: There are three categories of supplementary feeds where users can enter information regarding the supplements used on their own farms. The three categories are 'supplementary concentrate feeds', 'Forages brought in' and 'Forage crops'. Forage crops, whether bought in or grown on the area under consideration, are treated as a supplementary feed in order to accurately estimate the amount of grass harvested on the area under consideration. Within some of the categories there are options for 'Other' feeds which have not been included automatically but can be entered manually by users. For each supplementary feed, three entries are required, the amount fed (t of fresh weight), the dry matter of the feed and the UFL value of the feed. Cells should only be completed if the feeds were brought onto the area of the farm under consideration.

Tonnes fresh (amount fed in t fresh weight): The amount of supplement fed to the animals grazing the area under consideration should be entered here. It is important to enter the amount of supplementary feed that has been fed as accurately as possible so as to avoid over or under estimation of the amount of grass harvested.

Dry Matter % (The DM content of the feed): The nutrients available to animals from feeds are contained in the DM proportion of the feed. Different supplements will have different DM contents. The average DM content of the feeds is provided, however users can change the DM content of the feed if they feel that the DM is higher or lower than the average figure given.

UFL (Quality of the feed): Users are given a choice as to the quality of the supplement that is being used on their farm. The default setting is 'average' quality. However, users can also select either 'poor' or 'good' for each feed, which will change the energy (UFL) value of the feed up or down by 7 per cent.

Silage surplus: Surplus silage stocks, beyond that required for the housing period, should be entered here.

Input 1: This button will bring users back to Input Sheet 1.

Results: This button will bring users to the Results sheet.

When the details in this screen have been entered, users have the option of returning to Input Sheet 1, in order to amend any details, or of reviewing the Results.

Results

Insert name:

Main Results

Total grass harvested per year	6.4	(*t DM/ha per year)

*Assuming 1 UFL = 1 kg DM

Additional Results

Energy requirements		
Energy requirements for milking cow herd	249103	(UFL)
Total energy requirements for other stock	0	(UFL)
Breakdown:		
Weaning to 1 year	0	(UFL)
1 to 2 years	0	(UFL)
> 2.0 years	0	(UFL)
Total energy required	249103	(UFL)
Energy supplied		
Total energy supplied by bought in concentrate	51801	(UFL)
Total energy supplied by bought in forage and forage crops	0	(UFL)
Total energy supplied by supplements	51801	(UFL)
Balance of energy		
Balance of energy supplied by grazed grass and silage	204700	(UFL)
Feed conversion efficiency	86	(kg MS per tonne DM)
Surplus silage produced	0	
Milk solids yield		
Milk solids per cow	386	(kg)
Milk solids per hectare	687	(kg)
Stocking rate	1.78	(LU/ha)
Grazing season length	230	(days)
Percentage of diet from homegrown grass	79	(%)

Print

Re-start

Figure 7. Results sheet of 'The Grass Calculator'.

Grass Harvested

Total grass harvested per year (t DM/ha, assuming 1 UFL = 1 kg DM): This is the estimated total amount of grass harvested by grazing and silage on the area under consideration in the last 12 months.

Energy Requirements

Energy requirements for the milking cow herd: The total annual energy requirements (UFL) of all the cows milking in the herd on the area under consideration.

Total energy requirements for other stock: The total annual energy requirements (UFL) of stock other than dairy cows while on the area under consideration. This has been broken down into the energy requirements of each of the individual categories of other stock.

Total energy required: The total calculated energy requirements for all stock on the area under consideration over the 12 month period.

Energy supplied

Total energy supplied by bought in concentrate: The total amount of energy (UFL) supplied by bought in concentrates over the 12 month period on the area under consideration.

Total energy supplied by bought in forage and forage crops: The total amount of energy (UFL) supplied by home grown or bought in forage crops over the 12 month period on the area under consideration.

Total energy supplied by supplements: The total amount of energy (UFL) supplied by supplementary feeds over the 12 month period on the area under consideration.

Balance of energy supplied by grazed grass and grass silage: The total amount of energy (UFL) supplied by grazed grass and silage for the 12 month period on the area under consideration. This is calculated by subtracting the total energy provided by bought in supplement plus the total NE provided by forage crops from the total energy requirements.

Other Results/Outputs

Feed conversion efficiency (kg of MS per t of feed): This is the amount of milk solids produced per tonne of feed (UFL equivalent). This is calculated by dividing the total kg of MS produced by the total feed consumed. If other livestock are on the area under consideration they are included in this calculation.

Surplus silage produced: This is the amount of surplus silage that was produced on the area under consideration during the year.

Milk solids yield per cow: This is the milk solids yield per cow during the year.

Milk solids yield per hectare: This is the milk solids yield per hectare during the year.

Stocking rate: This is the number of livestock units per hectare on the area under consideration and includes all stock on the farm.

Grazing season length: This is the grazing season length calculated from the turnout and housing dates and from the number of cows calved in each month of the year.

Percentage of diet from home grown grass: This is the percentage of the total diet which comes from grazed grass and silage harvested from the area under consideration.

Print: This button will print a copy of the Results sheet.

Restart: This button will bring users back to the opening sheet.

Case studies

Data for four case study 'farms' are presented in Table 1 below (more detailed information regarding the inputs and results of these 'farms' can be found in appendices 1 to 4). These 'farms' are presented to illustrate some of the main points that were discussed in the introduction and to highlight the importance of harvesting as much grass as possible on farm.

Farm 1 represents the 'average' dairy farm in Ireland and is based on National Farm Survey data (NFS, 2008).

Farm 2 represents the top 10 per cent of farms from the National Farm Survey in terms of net profit per hectare (NFS, 2008).

Farm 3 is based on the Curtins Research Unit low stocking rate treatment (2.5 cows/ha) where 90 per cent of the winter feed requirement is made on farm.

Farm 4 is based on the Curtins Research Unit high socking rate treatment (3.28 cows/ha) where only approximately 50 per cent of the winter feed requirement is made on farm with the other 50 per cent imported.

Table 1. Summary details of case study farms

Farm	1	2	3	4
Land associated with dairy (ha)	32	31	9.17	7.01
Milk produced (litres)	289,946	376,669	126,924	110,646
Fat (%)	3.93	4.02	4.17	4.25
Protein (%)	3.43	3.50	3.60	3.58
Stocking rate (LU/ha)	1.78	2.13	2.51	3.28
Mean calving date	20th March	17th March	12th Feb	12th Feb
Grazing season length (days)	230	250	277	277
Concentrate per cow (kg)	988	821	541	519
Net profit (€/ha)	1095	2494	NA	NA
Grass harvested (t DM/ha*)	6.4	8.6	10.4	11.3

*UFL equivalent

Key points

- Farm 1 harvested the least amount of grass due to a low stocking rate, a short grazing season length and high levels of concentrate supplementation per cow.

- Farm 2 harvested more grass than Farm 1 due to a higher stocking rate, a longer grazing season length, reduced concentrate supplementation and increase milk production.

- Farm 4 harvested the most grass followed by Farm 3. Farms 3 and 4 had the same grazing season length and similar concentrate supplementation. Farm 4 however, had a higher stocking rate than Farm 3 which resulted in a further increase in grass harvested.

- Farms that harvested more grass are characterised by:

    - higher stocking rates
    - longer grazing season length (earlier turnout and later housing dates)
    - reduced concentrate supplementation
    - earlier mean calving dates
    - higher milk output per hectare

Conclusions

'The Grass Calculator' has been developed to provide the Irish dairy industry with a robust, scientifically sound method for calculating the amount of grass harvested (tonnes DM/ha) on-farm annually. As grass utilisation is closely linked to profitability, 'The Grass Calculator' should be used in conjunction with preparing the annual financial results to inform farm decision making on culling/replacement practices as well as grazing management and supplementation policy.

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Appendix 1. Farm 1 – Average NFS (2008)

Input Sheet 1

Enter values in each of the orange cells below, then click on Input 2

Land Area
Ha: 32

Dairy cows
Cow numbers: 57
Liveweight (kg): 530

Other stock

	Number	Days on farm
Weaning to 1 year	0	365
1 to 2 years	0	365
> 2 years	0	365

Milk deliveries

	Inputs
Farm milk delivered, litres	273284
Milk fed to calves, litres	16662
Milk protein, %	3.43
Milk fat, %	3.93
Milk lactose ,%	4.7

Condition score change
Precalving condition score: 3.25
Minimum condition score: 2.75

Fertility
Herd empty rate, %: 20
Number of first lactation animals: 11
Number of second lactation animals: 10

Start date of year: 01/01/2008

Grazing season length

	Day	Night
Turnout date	04/03/2008	24/03/2008
Housing date	03/11/2008	03/11/2008

Number of cows calved in each month

January	February	March	April	May	June	July	August	September	October	November	December
5	18	16	8	4	1	1	0	1	1	1	1

Input 2

Input Sheet 2

Enter values in each of the orange cells below, then click on Results

		Tonnes Fresh	Quality	UFL	Dry matter %
Supplementary concentrate feeds	Bought in concentrate	55.7	Average	0.93	88
	Barley		Average	1	87
	Citrus		Average	1.01	89
	Soya hulls		Average	0.91	90
	Soyabean meal		Average	1.02	88
	Rapeseed		Average	1.11	90
	Brewers grains		Average	0.17	20.5
	Wheat		Average	0.99	86
	Oats		Average	0.89	87
	Maize grain		Average	1	87
	Palm kernal		Average	0.77	87
Other	Please specify				
	Please specify				
Forages brought in	Grass silage		Average	0.75	20
	Maize silage		Average	0.75	28
	Whole crop silage		Average	0.64	35
	Hay		Average	0.69	85
	Barley straw		Average	0.44	88
	Wheaten straw		Average	0.42	88
	Oaten straw		Average	0.5	88
	Zero grazed grass		Average	1	18
Forage crops	Swedes		Average	0.14	11.5
	Kale		Average	0.13	12
	Forage rape		Average	0.13	12
	Fodder beet		Average	0.22	19
Other	Please specify				
	Please specify				
	Please specify				
	Please specify				
Silage surplus	Inventory or sales				20

Input 1

Results

Insert name:	

Main Results

Total grass harvested per year	6.4	(*t DM/ha per year)

*Assuming 1 UFL = 1 kg DM

Additional Results

Energy requirements		
Energy requirements for milking cow herd	249103	(UFL)
Total energy requirements for other stock	0	(UFL)
Breakdown:		
Weaning to 1 year	0	(UFL)
1 to 2 years	0	(UFL)
> 2.0 years	0	(UFL)
Total energy required	249103	(UFL)
Energy supplied		
Total enegry supplied by bought in concentrate	51801	(UFL)
Total energy supplied by bought in forage and forage crops	0	(UFL)
Total energy supplied by supplements	51801	(UFL)
Balance of energy		
Balance of energy supplied by grazed grass and silage	204700	(UFL)
Feed conversion efficiency	86	(kg MS per tonne DM)
Surplus silage produced	0	
Milk solids yield		
Milk solids per cow	386	(kg)
Milk solids per hectare	687	(kg)
Stocking rate	1.78	(LU/ha)
Grazing season length	230	(days)
Percentage of diet from homegrown grass	79	(%)

Print

Re-start

Appendix 2. Farm 2 – Top 10 % of NFS (2008) based on net profit per hectare

Input Sheet 1

Enter values in each of the orange cells below, then click on Input 2

Land Area

Ha	31

Dairy cows

Cow numbers	66
Liveweight (kg)	530

Other stock

	Number	Days on farm
Weaning to 1 year	0	365
1 to 2 years	0	365
> 2 years	0	365

Milk deliveries

	Inputs
Farm milk delivered, litres	376669
Milk fed to calves, litres	
Milk protein, %	3.5
Milk fat, %	4.02
Milk lactose ,%	4.7

Condition score change

Precalving condition score	3.25
Minimum condition score	2.75

Fertility

Herd empty rate, %	20
Number of first lactation animals	13
Number of second lactation animals	12

Start date of year 01/01/2008

Grazing season length

	Day	Night
Turnout date	16/02/2008	08/03/2008
Housing date	09/11/2008	09/11/2008

Number of cows calved in each month

January	February	March	April	May	June	July	August	September	October	November	December
8	27	17	8	2	0	0	0	1	4	3	1

Input 2

Input Sheet 2

Enter values in each of the orange cells below, then click on Results

		Tonnes Fresh	Quality	UFL	Dry matter %
Supplementary concentrate feeds	Bought in concentrate	54	Average	0.93	88
	Barley		Average	1	87
	Citrus		Average	1.01	89
	Soya hulls		Average	0.91	90
	Soyabean meal		Average	1.02	88
	Rapeseed		Average	1.11	90
	Brewers grains		Average	0.17	20.5
	Wheat		Average	0.99	86
	Oats		Average	0.89	87
	Maize grain		Average	1	87
	Palm kernal		Average	0.77	87
Other	Please specify				
	Please specify				
Forages brought in	Grass silage		Average	0.75	20
	Maize silage		Average	0.75	28
	Whole crop silage		Average	0.64	35
	Hay		Average	0.69	85
	Barley straw		Average	0.44	88
	Wheaten straw		Average	0.42	88
	Oaten straw		Average	0.5	88
	Zero grazed grass		Average	1	18
Forage crops	Swedes		Average	0.14	11.5
	Kale		Average	0.13	12
	Forage rape		Average	0.13	12
	Fodder beet		Average	0.22	19
Other	Please specify				
	Please specify				
	Please specify				
	Please specify				
Silage surplus	Inventory or sales				20

Input 1

Results

Insert name:	

Main Results

Total grass harvested per year	8.6	(*t DM/ha per year)

*Assuming 1 UFL = 1 kg DM

Additional Results

Energy requirements		
Energy requirements for milking cow herd	309510	(UFL)
Total energy requirements for other stock	0	(UFL)
Breakdown:		
Weaning to 1 year	0	(UFL)
1 to 2 years	0	(UFL)
> 2.0 years	0	(UFL)
Total energy required	309510	(UFL)
Energy supplied		
Total enegry supplied by bought in concentrate	50220	(UFL)
Total energy supplied by bought in forage and forage crops	0	(UFL)
Total energy supplied by supplements	50220	(UFL)
Balance of energy		
Balance of energy supplied by grazed grass and silage	265977	(UFL)
Feed conversion efficiency	92	(kg MS per tonne DM)
Surplus silage produced	0	
Milk solids yield		
Milk solids per cow	442	(kg)
Milk solids per hectare	941	(kg)
Stocking rate	2.13	(LU/ha)
Grazing season length	250	(days)
Percentage of diet from homegrown grass	84	(%)

Print

Re-start

Appendix 3. Farm 3 – Curtins Farm low stocking rate system with 2.5 cows/ha and 90 % of winter feed made on-farm

Input Sheet 1

Enter values in each of the orange cells below, then click on Input 2

Land Area

Ha	9.17

Dairy cows

Cow numbers	23
Liveweight (kg)	526

Other stock

	Number	Days on farm
Weaning to 1 year	0	365
1 to 2 years	0	365
> 2 years	0	365

Milk deliveries

	Inputs
Farm milk delivered, litres	126924
Milk fed to calves, litres	0
Milk protein, %	3.6
Milk fat, %	4.17
Milk lactose ,%	4.72

Condition score change

Precalving condition score	3.19
Minimum condition score	2.79

Fertility

Herd empty rate, %	17
Number of first lactation animals	7
Number of second lactation animals	6

Start date of year 01/01/2010

Grazing season length

	Day	Night
Turnout date	25/01/2010	25/01/2010
Housing date	20/11/2010	20/11/2010

Number of cows calved in each month

January	February	March	April	May	June	July	August	September	October	November	December
8	11	4	0	0	0	0	0	0	0	0	0

Input 2

Input Sheet 2

Enter values in each of the orange cells below, then click on Results

		Tonnes Fresh	Quality	UFL	Dry matter %
Supplementary concentrate feeds	Bought in concentrate	12.4	Average	0.93	88
	Barley		Average	1	87
	Citrus		Average	1.01	89
	Soya hulls		Average	0.91	90
	Soyabean meal		Average	1.02	88
	Rapeseed		Average	1.11	90
	Brewers grains		Average	0.17	20.5
	Wheat		Average	0.99	86
	Oats		Average	0.89	87
	Maize grain		Average	1	87
	Palm kernal		Average	0.77	87
Other	Please specify				
	Please specify				
Forages brought in	Grass silage	9.5	Average	0.75	35
	Maize silage		Average	0.75	28
	Whole crop silage		Average	0.64	35
	Hay		Average	0.69	85
	Barley straw		Average	0.44	88
	Wheaten straw		Average	0.42	88
	Oaten straw		Average	0.5	88
	Zero grazed grass		Average	1	18
Forage crops	Swedes		Average	0.14	11.5
	Kale		Average	0.13	12
	Forage rape		Average	0.13	12
	Fodder beet		Average	0.22	19
Other	Please specify				
	Please specify				
	Please specify				
	Please specify				
Silage surplus	Inventory or sales				20

Input 1

Results

Insert name:	

Main Results

Total grass harvested per year	10.4	(*t DM/ha per year)

*Assuming 1 UFL = 1 kg DM

Additional Results

Energy requirements		
Energy requirements for milking cow herd	108227	(UFL)
Total energy requirements for other stock	0	(UFL)
Breakdown:		
Weaning to 1 year	0	(UFL)
1 to 2 years	0	(UFL)
> 2.0 years	0	(UFL)
Total energy required	108227	(UFL)
Energy supplied		
Total enegry supplied by bought in concentrate	11532	(UFL)
Total energy supplied by bought in forage and forage crops	2494	(UFL)
Total energy supplied by supplements	14026	(UFL)
Balance of energy		
Balance of energy supplied by grazed grass and silage	95752	(UFL)
Feed conversion efficiency	93	(kg MS per tonne DM)
Surplus silage produced	0	
Milk solids yield		
Milk solids per cow	442	(kg)
Milk solids per hectare	1108	(kg)
Stocking rate	2.51	(LU/ha)
Grazing season length	277	(days)
Percentage of diet from homegrown grass	87	(%)

Print

Re-start

Appendix 4. Farm 4 – Curtins Farm high stocking rate system with 3.28 cows/ha and 50 % of winter feed bought-in

Input Sheet 1

Enter values in each of the orange cells below, then click on Input 2

Land Area

Ha	7.01

Dairy cows

Cow numbers	23
Liveweight (kg)	502

Other stock

	Number	Days on farm
Weaning to 1 year	0	365
1 to 2 years	0	365
> 2 years	0	365

Milk deliveries

	Inputs
Farm milk delivered, litres	110646
Milk fed to calves, litres	0
Milk protein, %	3.58
Milk fat, %	4.25
Milk lactose ,%	4.66

Condition score change

Precalving condition score	3.17
Minimum condition score	2.69

Fertility

Herd empty rate, %	17
Number of first lactation animals	7
Number of second lactation animals	6

Start date of year 01/01/2010

Grazing season length

	Day	Night
Turnout date	25/01/2010	25/01/2010
Housing date	20/11/2010	20/11/2010

Number of cows calved in each month

January	February	March	April	May	June	July	August	September	October	November	December
8	10	4	1	0	0	0	0	0	0	0	0

Input 2

Input Sheet 2

Enter values in each of the orange cells below, then click on Results

		Tonnes Fresh	Quality	UFL	Dry matter %
Supplementary concentrate feeds	Bought in concentrate	11.9	Average	0.93	88
	Barley		Average	1	87
	Citrus		Average	1.01	89
	Soya hulls		Average	0.91	90
	Soyabean meal		Average	1.02	88
	Rapeseed		Average	1.11	90
	Brewers grains		Average	0.17	20.5
	Wheat		Average	0.99	86
	Oats		Average	0.89	87
	Maize grain		Average	1	87
	Palm kernal		Average	0.77	87
Other	Please specify				
	Please specify				
Forages brought in	Grass silage	41.5	Average	0.75	35
	Maize silage		Average	0.75	28
	Whole crop silage		Average	0.64	35
	Hay		Average	0.69	85
	Barley straw		Average	0.44	88
	Wheaten straw		Average	0.42	88
	Oaten straw		Average	0.5	88
	Zero grazed grass		Average	1	18
Forage crops	Swedes		Average	0.14	11.5
	Kale		Average	0.13	12
	Forage rape		Average	0.13	12
	Fodder beet		Average	0.22	19
Other	Please specify				
	Please specify				
	Please specify				
	Please specify				
Silage surplus	Inventory or sales				20

Input 1

Results

Insert name:	

Main Results

Total grass harvested per year	11.3	(*t DM/ha per year)

*Assuming 1 UFL = 1 kg DM

Additional Results

Energy requirements		
Energy requirements for milking cow herd	99731	(UFL)
Total energy requirements for other stock	0	(UFL)
Breakdown:		
Weaning to 1 year	0	(UFL)
1 to 2 years	0	(UFL)
> 2.0 years	0	(UFL)
Total energy required	99731	(UFL)
Energy supplied		
Total enegry supplied by bought in concentrate	11067	(UFL)
Total energy supplied by bought in forage and forage crops	10894	(UFL)
Total energy supplied by supplements	21961	(UFL)
Balance of energy		
Balance of energy supplied by grazed grass and silage	79096	(UFL)
Feed conversion efficiency	88	(kg MS per tonne DM)
Surplus silage produced	0	
Milk solids yield		
Milk solids per cow	388	(kg)
Milk solids per hectare	1273	(kg)
Stocking rate	3.28	(LU/ha)
Grazing season length	277	(days)
Percentage of diet from homegrown grass	78	(%)

Print

Re-start

Notes

Notes

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Agriculture and Food Development Authority

National Development Plan 2007 - 2013