UCD Lyons Systems Herd Annual Report for 2020

Project Title: Development of a Profitable High-Output Grass-Based Spring Milk Production System

Rationale: It is widely recognised that grass-based dairy systems will predominate in Ireland. However, grazing systems that have been developed to utilise large quantities of grazed grass have in the main been based on low output per cow. In this scenario, high levels of profitability are possible through avid cost control and comparatively high stocking rates for grazing systems. There are now reasons to consider the development of grazing systems that are based on high output per cow. These reasons include (i) concerns about increasing dairy cow numbers and environmental emissions, (ii) facilitating farm expansion for land limited and fragmented farms, (iii) lack of available skilled labour on farms and (iv) lack of infrastructure on farms to deal with expanding animal numbers.

Given the significant costs associated with expansion and the fact that many farmers are operating on a land-bank that is limiting the expansion of their business, a higher input – higher output spring calving grazing system may offer an opportunity to grow the dairy business. Such a system might facilitate the successful expansion of the farm business without the need to buy or rent extra land, to buy stock, to acquire extra labour or to provide extra cow facilities. The focus in such a system is on maximising milk/milk solids output from the existing land holding which involves high output from individual cows. This will occur most efficiently through maximising the use of grazed grass/home grown forage in the system and the strategic use of supplementation thereafter.

Project objectives:

- To develop a profitable high-input high-output grass-based spring milk production system
- To incorporate the most recent advances in grassland management for dairy farms into a high-output system
- Use a type of dairy cow that has good genetic indices for both milk production and fertility
- Employ the best practices from nutrition research and dairy cow husbandry
- Incorporate nutritional studies into a high-input high-output system
- To incorporate management technologies and system attributes that enhance the environmental sustainability of dairy production

Description of the project:

The targets for the system are presented in Table 1. The average genetic merit of the herd in January 2020 is presented in Table 2. In the January 2020 evaluation, the overall herd EBI and Milk SI (sub-index) were within the top 1% nationally and herd fertility SI was in the top 5%. Cows calved from the 23rd January to 6th April 2020. The feed budget is calculated on a days in milk (DIM) basis (Table 3).

Table 1: Targets for the system

Parameter	Target
Stocking rate on milking platform	3.4 LU/ha
Stocking rate whole farm	2.4 LU/ha
Milk yield kg/cow	7,500-8,000
Milk solids kg/cow	625
6-Week in calf rate	75%
Concentrate (kg/cow/year)	1,500
% diet as grazed grass	>51
% diet as grazed grass and grass silage	>75

Table 2: Genetic merit of the herd (January 2020 evaluations)

EBI	Milk	Fertility	Calving	Beef	Maint.	Health	Mgt
206 (Top 1%)	69 (Top 1%)	87 (Top 5%)	43 (Top 1%)	-9 (Top 40%)	8 (Top 90%)	5 (Top 5%)	3 (Top 20%)
Milk kg	**Fat kg**	**Prot. Kg**	**Fat %**	**Prot. %**	**Calv int.**	**Surv %**	
140 (Top 20%)	13 (Top 1%)	9 (Top 5%)	0.14 (Top 5%)	0.08 (Top 10%)	-4.1 (Top 99%)	2.9 (Top 1%)	

Table 3: Feed budget for 2020 (Target allowances and actual feed budget for the year).

Days in milk	0-20	21-60	61-90	91-120	121-180	181-240	241-270	271-305	306 - 343	344-365	Total annual (Est)	Total annual (actual)
Silage kg DM/cow/day	5	0	0	0	0	0	5	15	10.7	9.5	1.3t DM	1.7t DM
Grass kg DM/cow/day	10	15	15	15	15	14	7.5	7.5	0	0	3.5t DM	3.3t DM
Concentrate kg/cow/day	8	8	7.5	6	3.5	3	3	3	0	0	1.5t As fed	1.4t As fed

2020 Production Performance

Table 4: Herd milk performance in 2016 -2020 compared to the targets

Parameter	Target	2016	2017	2018	2019	2020
Cow numbers	60	58	60	59	58	57
Milking Platform ha	17.64	17.58	17.65	17.65	17.52	17.43
Silage ha	9	9	7	7	7	7
Whole farm ha	26.6	26	24.65	24.65	24.52	24.43
SR on MP	3.4	3.3	3.4	3.34	3.31	3.27
SR whole farm	2.25	2.18	2.4	2.4	2.34	2.33
% heifers in herd	22	22.4	23.3	28	21	23
Average lactation days	305	301	305	305	304	305
Average fat %	4.50	4.60	4.49	4.45	4.33	4.48
Average protein %	3.60	3.56	3.66	3.62	3.60	3.59
Average lactose %	4.50	4.51	4.48	4.54	4.53	4.56
Average SCC	<120,000	111,000	91,500	154,000	56,000	58,000
Yield/ kg cow (305d)	7750	7441	7548	6680	7541	7771
Milk solids kg/cow (305d)	625	592	602	558	597	621
Yield kg/cow (actual)	7750	7407	7466	6790	7381	7503
Milk solids kg /cow (actual)	625	588	595	544	586	606
Milk solids kg /ha MP	2125	1953	2023	1850	1940	1980
Milk solids kg/ha whole farm	1521	1291	1428	1306	1371	1413

Table 5: 2020 Grass production data

Grass Production Parameter	
Opening cover on 17th Jan 2020 (kg DM/ha)	791
Total grass grown (t/ha)	13.6
Total number of grazings	8.5
Closing cover on 1st December 2020 (kg DM/ha)	711
Stocking rate on MP	3.27
Nitrogen (kg N/ha)	235
Phosphorus (kg P/ha)	4.6
Potassium (kg K/ha)	84.7
Turnout by day	6th February
Turnout full time	19th March
Housed by night	29th October
Full time housing	11th November
Total days at grass	246
Silage (bales) on MP (t/ha)	1.4
Herbage utilized t/ha	12.1
Grazed grass utilized t/ha	10.7
Grazed grass utilized t/cow	3.3
Milk from forage (kg)	4,612

Breeding 2020:

The breeding season totalled 10 weeks; commenced on Saturday 2nd May and finished on 10th July. A total of 54 cows were submitted for breeding. The three-week submission rate was 91% (49/54 cows in the breeding herd) and the 24-day submission rate (2nd -26th May) was 98% (53/54 cows in the breeding herd). The first service-conception rate was our highest to date at 74% (40/54 cows). The number of cows that required a second serve to conceive was 24% (13/54 cows) with one cow requiring a third serve (2%). The 6-week pregnancy rate was 87% and pregnancy rate at the end of the breeding season was 96% (52/54 cows). The empty rate was 9% and this consisted of two cows that failed to conceive and three cows that were not bred.

Breeding was all done by AI twice daily. Bulls being used were FR4728 (Kilfeacle Pivotal), FR5593 (Oakglen Cosmic), FR4573 (VH Praser), FR4439 (Killalough Samir), FR5239 (Hanrahan Olympus), FR4785 (Glenaboy Ronald), FR4608 (Fly-Higher Mod Cade-Et), OPH (Olcastletown Phanthom), FR2314 (Gortcreen Sebastain), FR4686 (Mountdudley Joker) and FR5085 (Lars-Acres Super Nerd).

The weighted EBI averages of these bulls used were as follows:

EBI €	Milk S.I.	Fert S.I.	Calv €	Beef €	Maint €	Mmgt €	Hlth €	Milk kg	F kg	P kg	F%	P%
266	105	108	41	-7.9	3.6	4	12.1	244	20.8	14.2	0.19	0.1

These bulls were selected based on high milk production and components, while maintaining high fertility. Eleven bulls were selected to increase bull team reliability. As all cows had been inseminated with dairy bulls during the first 6 weeks of the breeding season, for the remainder of the breeding season five selected beef bulls were used. The beef bulls used were AU4309 (Deerpark Kevin), AU4563 (Johnstown Loyd 1039), AA4235 (Gabriel Mossy 1727) and LM2014 (Ewdenvale Ivor). Heat detection was conducted using Moo Monitors, and scratch cards.

Breeding Results 2020:

Table 6: Percentage of cows submitted by breeding season week in 2020

	% of cows submitted (numbers)
Week 1	28% (15/54)
Week 2	63% (34/54)
Week 3	91% (49/54)
Week 4	98% (53/54)
Week 5	98% (53/54)
Week 6	100% (54/54)

Table 7: Fertility comparison 2016-2020

	2016	**2017**	**2018**	**2019**	**2020**
Number of Cows	58	59	60 (55 submitted)	58 (56 submitted)	57 (54 submitted)
Submission Rate 21 d %	91	90	96	95	91
First Service Conception Rate %	43	50	69	64	74
6-week in calf Rate %	59	54	83	79	87
Resultant 6 week calving rate the following year %	83% (23% 1st lactation)	85% (28% 1st lactation)	93% (23% 1st lactation)	93% (20% 1st lactation)	-
Empty Rate % (all cows)	9 (12 wks)	15 (13 wks)	13 (12 wks)	12 (11 wks)	9 (10 wks)

Financial Simulation

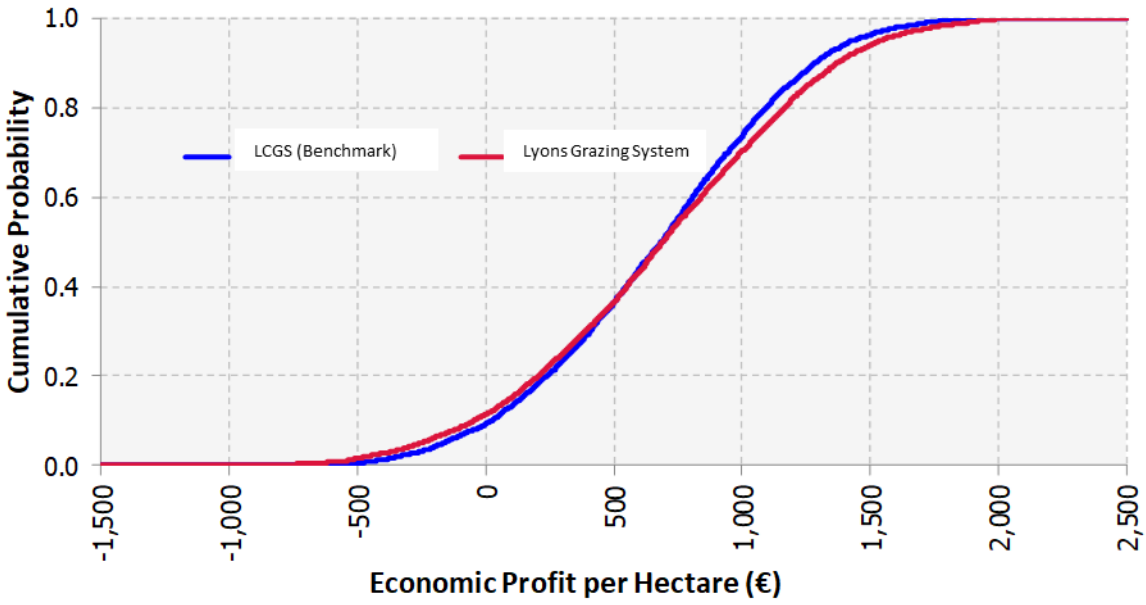
In order to evaluate the profitability of the Lyons dairy system, financial simulations were undertaken. To do this, the Lyons Grazing System was compared to a benchmark low concentrate grazing system (LCGS), using characteristics as described in Table 8. This was a full assessment of production with labour priced at €15/hour, imputed rent (all land) at €420/ha and interest of capital at 5%. The milk output value was based on a milk base price of 30c/litre and concentrates were priced at €340/t DM.

Table 8: The characteristics of the benchmark LCGS and the Lyons grazing system

	Low concentrate grazing system (LCGS)	**UCD Lyons grazing system**
Stocking rate (LU/ha)	2.75	2.4
Milk yield (kg/cow)	5,550	7,450
Milk solids (kg/cow)	450	590
Concentrate (kgDM/cow/yr)	350	1,300
% diet grazed grass	74	53
% diet grazed grass and silage	90	78

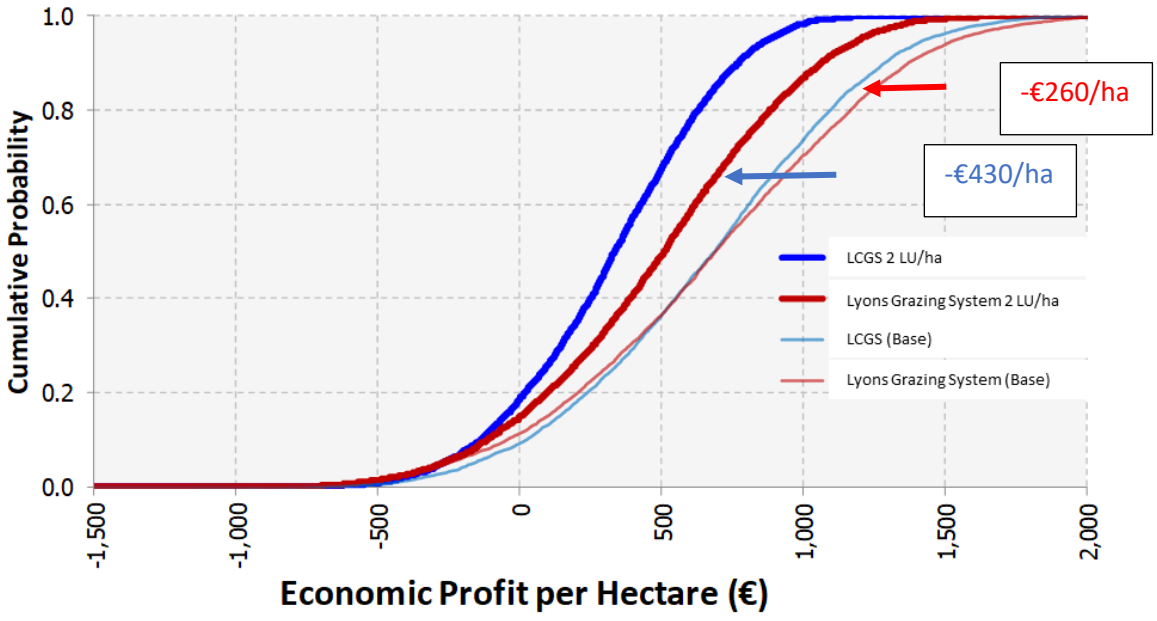
A cumulative profit distribution analysis was carried out to compare the economic performance of the Lyons Grazing System to the benchmark Low Concentrate Grazing System (LCGS). The horizontal axis charts the profit/ha performance (- €1,500 to €2,500 in increments of €500) and the vertical axis charts the cumulative probability (Figure 1). This analysis enables the assessment of each system's probability of being below each profitability/ha performance increment. For example, at the breakeven point of €0, the systems had similar probabilities of being below that level of about 10%. At the midpoint probability rate of 50%, both systems had similar levels of profit/ha. However, at the upper end of the distribution, the Lyons Grazing System provides an upside economic potential when milk prices are high. This is due to the higher levels of milk production in the Lyons Grazing System than as simulated in the LCGS. Despite this, when milk prices are lower, the Lyons Grazing System can lead to lower levels of profit. Overall, the level of risk is similar between the two systems.

Figure 1. Comparison of the cumulative profit distributions of the LCGS and Lyons Grazing System for profit/ha



A Monte Carlo analysis was performed to compare the level of profit/ha in a non-derogation scenario where stocking rates are reduced in both the Lyons Grazing System and LCGS system to 2.0 LU/ha (Figure 2). Firstly, each system's current base figures are presented in the thin distribution lines. When the proposed SR restriction of 2 LU/ha is included in the simulation, both systems experience a reduction in profit through the simulated removal of the nitrates derogation. The average profitability loss is €260/ha for the Lyons Grazing System and €430/ha for the LCGS. This analysis illustrates that the Lyons Grazing System can perform to a superior degree if SR is curtailed to 2.0LU/ha. This is due to the higher levels of output/cow which is a characteristic of the Lyons Grazing System.

Figure 2. Comparison of the cumulative profit distributions of the LCGS and MCGS with and without nitrates derogation scenarios.



Recent research

2019

It is well established that in high crude protein diets, the amount of protein degraded in the rumen can be in over supply. If the rumen degradable protein exceeds microbial needs, large amounts of NH3 are produced, absorbed into the blood, converted to urea in the liver, excreted in the urine and thus lost to the environment. It is therefore advantageous to use lower protein concentrates at grass. Therefore, our aim was to compare high and low crude protein % in the concentrate for grazing cows.

- Treatment 1= 30 cows offered high CP concentrate (18%) throughout the main grazing season
- Treatment 2= 30 cows offered a low CP concentrate (14%) for the main grazing season

Statistical analysis was carried out to determine the milk production differences between both CP% groups during the main grazing season (2nd April-7th October 2019). Both groups had similar milk yields, fat kg, protein kg, MS kg, fat %, protein % and somatic cell count (SCC) (Table 9). These results indicate that the milk production of high EBI cows is not inhibited by reducing concentrate CP levels from 14%-18%.

Table 9. Differences in milk production between the 14% and 18% crude protein groups during the main grazing season in 2019.

Parameter (per day)	14% CP	18% CP	Significant Difference
Milk yield (kg)	29.9 ±0.83	29.4 ±0.85	No (P=0.38)
Fat (kg)	1.21 ±0.04	1.12 ±0.04	No (P=0.68)
Protein (kg)	1.06 ±0.03	1.03 ±0.03	No (P=0.45)
MS (kg)	2.27 ±0.06	2.21 ±0.07	No (P=0.54)
Fat (%)	4.08 ±0.08	4.10 ±0.08	No (P=0.90)
Protein (%)	3.56 ±0.03	3.52 ±0.03	No (P=0.42)
SCC (× 10^3 cells/ ml)	68.4 ±12.1	84.5 ±12.5	No (P=0.77)

2020:

Based on our 2019 findings, there was a continued focus to assess the effect of different concentrate crude protein levels on pasture dry matter intake, milk production and composition, body condition score, body weight, and nitrogen excretion for a high EBI, high-output grass-based spring calving herd. From 6th April to 10th October, cows were offered one of the following concentrates:

- **Treatment 1**= 18 cows offered 14% CP concentrate throughout lactation
- **Treatment 2**= 20 cows offered 12% CP concentrate formulated with native ingredients
- **Treatment 3**= 19 cows offered 12% CP concentrate formulated with non-native ingredients

Results so far indicate little difference in milk production from using a 12% protein concentrate and little impact of basing the 12% protein concentrate on native ingredients (barley, oats, beans) in comparison to a 14% CP concentrate with conventional formulation.

Table 10. The average milk production performance of the three concentrate groups during the 2020 study

	14% CP	**12% CP Native**	**12% CP Non-native**
Milk yield (kg/cow/day)	27.8	27.3	27.9
Fat (%)	4.37	4.43	4.33
Protein (%)	3.59	3.61	3.60
Fat and Protein (kg/cow/day)	2.13	2.13	2.13
SCC (,000)	68	68	72

****Final analysis and results of the 2020 crude protein study are pending**

2021 Trial

In 2021, research will again centre on concentrate type. For the main grazing season, 16 cows will be offered one of the following four concentrate diets:

• 14% CP commercial concentrate

• 12% CP commercial concentrate of non- native ingredient formulation

• 12% CP commercial concentrate of native ingredient formulation

• 12% CP commercial concentrate of native ingredient formulation with methionine supplementation

An 18% CP concentrate will be provided for first and last rotations, with the lower CP nut offered throughout the main grazing season (April-early October). Investigating the effects of including a lower concentrate crude protein level from native/non-native ingredients with and without methionine supplementation will help gain a novel insight into these strategies' effects on milk production and nitrogen loss of the cows. Previous research by members of our group found that methionine supplementation with a 15% CP concentrate diet can improve milk production.

Table 11: Genetic merit of the herd (January 2021 evaluation)

EBI	**Milk**	**Fertility**	**Calving**	**Beef**	**Maint.**	**Health**	**Mgt**
204 (Top 1%)	69 (Top 1%)	81 (Top 5%)	43 (Top 1%)	-10 (Top 40%)	11 (Top 30%)	6 (Top 5%)	3 (Top 20%)
Milk kg	**Fat kg**	**Prot. Kg**	**Fat %**	**Prot. %**	**Calv int.**	**Surv %**	
152 (Top 20%)	13 (Top 5%)	10 (Top 5%)	0.11 (Top 20%)	0.08 (Top 10%)	-4.1 (Top 99%)	2.4 (Top 1%)	

Measurements taken:

- Cows are milked twice daily at 0700 h and 1500 h and daily milk yield is recorded through the milking parlour
- Cows are milk recorded weekly by Progressive Genetics
- Cow body condition score is recorded every two weeks
- Cow body weight is recorded twice daily as the cows leave the milking parlour
- Grass measurements on a weekly basis for growth/quality/nutritional assessment
- Estimates of herbage intakes and nitrogen excretion are measured for research comparisons
- Fertility parameters (submission rates, conception rates and 6-week in-calf rate)

Dissemination:

- Weekly: Weekly notes are published on the Lyons Farm website (https://www.ucd.ie/lyonsfarm/research/dairyresearch/lyonssystemsresearchherdnotes/)
- Twitter: @UCD_SystemsHerd
- Ongoing: Industry groups are currently hosted through online webinars on an ongoing basis, including groups from the Department of Agriculture, Progressive Genetics and Teagasc.
- It is hoped that visits to the farm will resume when public health advice allows.
- 2021 Webinar: A webinar was held on 14th January 2021 for a wide audience where the herd's performance and research results were discussed. It was attended by 350 people which included viewers in Ireland, the United Kingdom and New Zealand.
- Scientific publications from the project are in preparation.