DAFM Request for information to inform policy development and responses to stakeholder queries. October 2023

Item 3 Other information to inform possible amendments to Table 6 of SI No 113 of 2022 (as amended) which sets out livestock nutrient excretion rates
It would be appreciated if Teagasc could provide data to support the following possible changes:

- **At present a 0-1 year old bovine is considered to excrete 24 kg of N and 3 kg of P in a calendar year. What would the excretion rates for that bovine be in the period when its 0-3months of age and 3-12 months of age or 3-6 months of age and 6 to 12 months of age?**

Background

At present 0-1 year old bovines are considered to excrete 24kg of N and 3kg of P across the year. The nationally applied methodology assumes that each day, week or month across the 0-12 month period is the same with no difference between one day old calves and 12 month old yearlings. In order to quantify the appropriate nutrient excretion rates relative to age a new process was required. This process involved creating a monthly feed budget for the differing animal categories across the different feeds offered, converting dry matter intake into protein intake and by dividing by 6.25 calculating nitrogen intake, calculating the amount of nitrogen retained in the animal through tissue and bone growth. Total nitrogen intake less nitrogen retained resulted in nitrogen excreted. Finally, the organic N excretion figure was calculated based on deducting the gaseous losses from the surplus nitrogen based on an assumption that 10% of the surplus nitrogen would be lost in a gaseous form. During the process of developing the methodology for this analysis, it became apparent that there was a need to have separate male and female categories included in the analysis. This involved separate growth rate assumptions from 12 to 24 months as well as separate intake as a percentage of live weight assumptions for different age groups. This was especially the case for months 18 to 24 for the replacement animals and for months 21 to 24 for the steers.

Studies

A study that looked at P levels in grass throughout the year has shown P levels in the range of 0.34%to 0.44% (Curran et al., 2013) when grass was sampled in March, May, August and October. When weighted for consumption throughout the year the average P levels corresponds to 0.36% per kg DM. For grass silage a similar figure was taken for the analysis. However this study was completed in 2013 which was an atypical year for grass with a tough spring and a significant drought within the one year. Another source of data was a commercial laboratory in the South of the country. The analysis from this lab for grass and grass silage, shows an average P concentration in grass of 0.388% per kg DM based on 1,000 samples and for grass silage it was 0.365% per kg DM across 6,000 samples. Similar discussions with another commercial laboratory had similar numbers (0.37% per kg DM for grass and 0.31% per kg DM for grass silage). Based on these different sources of data the average P concentration included in this analysis for grazed grass and grass silage was 0.380% and 0.313% per kg DM. Feedback from a number of Irish mills resulted in the average P level included in concentrate included at 0.56%/ kg DM. The P included for weight gain and calf live weight exports was 0.76% per kg live weight. This was based on a UK report published in 2006 on their nitrates and phosphorous outputs (0.8%/kg live weight) and a paper published by Hristov et al., (2006) (0.72%/kg live weight).

Table 1 shows the assumptions used in the analysis. Animal growth grates were assumed based on discussion with experts in the area and were representative of industry performance. Overall intake from month 4 were based on the animal consuming 2.4% of their live weight per day in dry matter intake between month 4 and month 8, 2.1% between month 8 and month 10 and 2% based on month 10 to month 12 (Costigan 2021). Female animals between 12 and 24 months were assumed to have intakes of 2% of live weight up to month 18, dropping to 1.8% of live weight for months 19 to 21, and dropping to 1.7%, 1.6% and 1.5% of live weight for months 22, 23 and 24. These assumptions were based on Costigan (2021). In relation to steers it was assumed intake remains at 2% of live weight from month 12 to month 21, ultimately dropping to 1.9% for the 22nd month and 1.8% for the 23rd and 24th months (Byrne per coms).

Table 1. Assumptions for 0-1 year old organic N calculations

	Protein	Phosphorous
Milk Replacer crude protein percentage (FM)	23	0.7
Hay crude protein percentage (FM)	10	0.38
Calf ration crude protein percentage (FM)	18	0.56
Concentrate crude protein percentage (FM)	15	0.504
Grazed grass crude protein percentage (DM)	18	0.38
Grass silage crude protein percentage (DM)	12.7	0.31
N content of retained liveweight	0.029	
P content of retained liveweight		0.0076

Table 2 shows the feed budget consumed by the 0-1 year old animal category. It includes 45kg of milk/milk replacer, 93kg of an 18% CP calf ration, 2.7kg of hay, 573kg of grazed grass dry matter, 304kg of grass silage dry matter and 168kg of a concentrate. For the purpose of this exercise it was assumed that both male and female animals up to 12 months of age would be similar and therefore, there was no differences assumed.

Table 2. Diet make up of calves from the dairy herd over the first year of their lives.

Month	Liveweight kg	Growth Rate kg/day	Milk Kg	Calf Ration kg	Hay Kg	Grazed Grass kg DM	Grass Silage KG DM	Concentrate kg
1	56	0.6	19	5	0	0	0	
2	74	0.6	19	8	1	0	0	
3	92	0.6	8	27	1	0	0	
4	110	0.6		27	1	46	0	
5	131	0.7		27		60	0	
6	152	0.7				102	0	
7	173	0.7				117	0	
8	200	0.9				87	0	30
9	227	0.9				105	0	30
10	247	0.65				57	57	36
11	266	0.65				0	118	36
12	286	0.65				0	129	36
Total Kg			45	93	2.7	573	304	168

Table 3 describes the nitrogen inputs and outputs of 0-1 year old animals. Total nitrogen intake increases from 0.81kg in the first month of life to 3.49kg in month 12. Live-weight gains were included as outputs within the analysis with the nitrogen content included at 0.029 per kg of live weight (ARC 1994). Similarly nitrogen retained within the animal based on liveweight change multiplied by 0.029 results in 0.52kg being retained in the first month of life and increasing to 0.78kg in months 7 to 9 and back to 0.57kg in the 12th month. Nitrogen excreted ranges from 0.28kg in month 1 to 2.93kg excreted in month 12. In order to calculate the organic N, gaseous losses were deducted based on 10% of the surplus nitrogen (recommended by the EU for Nitrates Derogation applications). This results in the organic N excretion being 0.26kg in the first month of life and increasing to 2.63kg in the 12th month.

Table 3. Nitrogen inputs and outputs of calves from the dairy herd over the first year of their lives.

Month	Milk	Calf Ration	Hay	Grazed Grass	Grass Silage	Conc	Total N Intake	N Retained	N Excreted	Gaseous Losses	Organic N excretion
1	0.68	0.13	0.00	0.00	0.00	0.00	0.81	0.52	0.28	0.03	0.26
2	0.68	0.22	0.01	0.00	0.00	0.00	0.90	0.52	0.38	0.04	0.34
3	0.27	0.78	0.01	0.00	0.00	0.00	1.06	0.52	0.54	0.05	0.49
4		0.78	0.02	1.32	0.00	0.00	2.11	0.52	1.59	0.16	1.43
5		0.78	0.00	1.72	0.00	0.00	2.50	0.61	1.89	0.19	1.70
6				2.93	0.00	0.00	2.93	0.61	2.33	0.23	2.09
7				3.37	0.00	0.00	3.37	0.61	2.76	0.28	2.49
8				2.52	0.00	0.72	3.24	0.78	2.46	0.25	2.22
9				3.01	0.00	0.72	3.73	0.78	2.95	0.30	2.65
10				1.63	1.15	0.86	3.64	0.57	3.08	0.31	2.77
11				0.00	2.39	0.86	3.26	0.57	2.69	0.27	2.42
12				0.00	2.63	0.86	3.49	0.57	2.93	0.29	2.63
Total Kg	1.6	2.7	0.0	16.50	6.2	4.0	31.0	7. 7	23.9	2.4	21

Table 4 describes the Phosphorous inputs and outputs of 0-1 year old animals. Total phosphorus intake increases from 0.2kg in the first month of life to 0.6kg in month 12. Similarly phosphorous retained within the animal results in 0.14kg being retained in the first month of life and increasing to 0.2 in from month 7. Phosphorous excreted ranges from 0.02kg in month 1 to 0.40kg excreted in month 12.

Table 4. Phosphorous inputs and outputs of calves from the dairy herd over the first year of their lives

Month	**Milk**	**Calf Ration**	**Hay**	**Grazed Grass**	**Grass Silage**	**Conc**	**Total P Intake**	**P Retained**	**P Excreted**
1	0.13	0.03					0.2	0.14	0.0
2	0.13	0.04	0.002				0.2	0.14	0.0
3	0.05	0.15	0.003				0.2	0.14	0.1
4		0.15	0.005	0.17			0.3	0.14	0.2
5		0.15		0.23			0.4	0.16	0.2
6				0.39			0.4	0.16	0.2
7				0.44			0.4	0.16	0.3
8				0.33		0.17	0.5	0.21	0.3
9				0.40		0.17	0.5	0.21	0.3
10				0.21	0.18	0.20	0.6	0.15	0.4
11					0.37	0.20	0.5	0.15	0.4
12					0.41	0.20	0.6	0.15	0.4
Total Kg	**0.3**	**0.5**	**0.01**	**2.2**	**1.0**	**0.9**	**4.8**	**1.9**	**2.9**

Table 5. shows the feed budget consumed by the 1-2 year old female animal category. It includes 1,645kg of grazed grass dry matter, 1,009kg of grass silage dry matter and 36kg of concentrate and is based on an average growth rate of 0.77kg per day for the period of 1 to 2 years

Table 5. Diet make up of 1 to 2 year olds (female) from the dairy herd.

Month	Liveweight kg	Growth Rate kg/day	Grazed Grass kg DM	Grass Silage KG DM	Concentrate kg
13	285	0.40	0	133	36
14	310	0.83	179	0	0
15	335	0.83	194	0	0
16	357	0.74	208	0	0
17	386	0.96	223	0	0
18	415	0.96	240	0	0
19	440	0.84	231	0	0
20	460	0.66	243	0	0
21	485	0.83	128	128	0
22	510	0.83	0	254	0
23	535	0.83	0	251	0
24	550	0.50	0	244	0
Total Kg			1,645	1,009	36

Table 6. Nitrogen and phosphorous inputs and outputs of female 1 to 2 year olds from the dairy herd.

Month	Nitrogen					Phosphorous		
	Total N Intake	N Retained	N Excreted	Gaseous Losses	Organic N excretion	Total P Intake	P Retained	P Excreted
13	3.6	0.3	3.3	0.3	3.0	0.6	0.1	0.5
14	5.1	0.6	4.5	0.5	4.1	0.7	0.2	0.4
15	5.6	0.6	5.0	0.5	4.5	0.7	0.1	0.7
16	6.0	0.5	5.4	0.5	4.9	0.8	0.3	0.5
17	6.4	0.7	5.7	0.6	5.2	0.8	0.2	0.6
18	6.9	0.7	6.2	0.6	5.6	0.9	0.3	0.6
19	6.7	0.6	6.0	0.6	5.4	0.9	0.1	0.8
20	7.0	0.5	6.5	0.7	5.9	0.9	0.1	0.8
21	6.3	0.6	5.7	0.6	5.1	0.9	0.2	0.7
22	5.2	0.6	4.6	0.5	4.1	0.8	0.2	0.6
23	5.1	0.6	4.5	0.4	4.0	0.8	0.2	0.6
24	5.0	1.4	3.6	0.4	3.2	0.8	0.1	0.7
Total Kg	69	8	61	6	55	10	2	8

Table 6 shows the nitrogen and phosphorous inputs and outputs and the organic N value for animals between 12 months and 24 months of age. The overall organic N figure is 55kg while the P excreted comes out as 8kg. As was seen in the 1 to 12 month category there is significant differences in the organic N per month from 3.0kg in Month 13 to 5.9kg in month 20. A similar trend is seen with phosphorous. It should be noted that the organic N is a function of intake and diet composition and therefore the increase in organic N and P value with age is not linear. It should also be noted that sensitivity was carried out on the impact of changes in concentrate feeding levels on the overall organic N. The results suggest that if concentrate

feeding was higher than included in the analysis that there would be no impact on organic N as it would be expected that the intake of grazed grass and grass silage would reduce.

Table 7. shows the feed budget consumed by the 1-2 year old male animal category. It includes 1,725kg of grazed grass dry matter, 829kg of grass silage dry matter and 456kg of concentrate and is based on an average growth rate of 0.84kg per day for the period of 1 to 2 years.

Table 7. Diet make up of 1 to 2 year olds (male) from the dairy herd.

Month	Liveweight kg	Growth Rate kg/day	Grazed Grass kg DM	Grass Silage KG DM	Concentrate kg
13	298	0.4	0	139	36
14	310	0.4	182	0	0
15	341	1.05	195	0	0
16	373	1.05	214	0	0
17	404	1.05	233	0	0
18	434	1	251	0	0
19	461	0.9	269	0	0
20	485	0.8	284	0	0
21	512	0.9	97	97	105
22	539	0.9	0	195	105
23	563	0.8	0	193	105
24	587	0.8	0	206	105
Total Kg			1,725	829	456

Table 8 shows the nitrogen and phosphorous inputs and outputs and the organic N value for male animals between 12 months and 24 months of age. The overall organic N figure is 61kg while the P excreted comes out as 9kg. As was seen in the 1 to 12 month category there is significant differences in the organic N per month from 3.1 kg in Month 13 to 6.8kg in month 20. A similar trend is seen with phosphorous. It should be noted that the organic N is a function of intake and diet composition and therefore the increase in organic N and P value with age is not linear.

Table 8. Nitrogen and phosphorous inputs and outputs of 1 to 2 year old males from the dairy herd.

Month	Nitrogen					Phosphorous		
	Total N Intake	N Retained	N Excreted	Gaseous Losses	Organic N excretion	Total P Intake	P Retained	P Excreted
13	3.7	0.3	3.4	0.3	3.1	0.6	0.1	0.5
14	5.2	0.3	5.0	0.5	4.5	0.7	0.1	0.6
15	5.6	0.8	4.9	0.5	4.4	0.7	0.2	0.5
16	6.2	0.8	5.4	0.5	4.9	0.8	0.2	0.6
17	6.7	0.8	6.0	0.6	5.4	0.9	0.2	0.6
18	7.2	0.7	6.5	0.7	5.9	1.0	0.2	0.7
19	7.7	0.6	7.1	0.7	6.4	1.0	0.2	0.8
20	8.2	0.6	7.6	0.8	6.8	1.1	0.2	0.9
21	6.8	0.6	6.1	0.6	5.5	1.2	0.2	1.0
22	6.0	0.6	5.3	0.5	4.8	1.1	0.2	0.9
23	5.9	0.6	5.4	0.5	4.8	1.1	0.2	0.9
24	6.2	0.6	5.6	0.6	5.1	1.2	0.2	1.0
Total Kg	75	7	68	7	61	11	2	9

The analysis presented here includes both steers and replacement females across the 0-1 year stage as one group and the 1-2 year stage of growth and development with males and females separated. The question has been posed around how the figures would look if there was one category that included males and

females in the 1 to 2 year category. One category including both the male and female animals would have an organic N of 58kg per year, while the excreted P figure is 9kg per year in years 1 to 2.

Summary

There is a dramatic difference in organic N excretion rates by month from month 1 to month 12 in the 0-12 month category with a similar trend observed in the 13-24 month category. Based on this it is difficult to justify the same N excretion rates being used for each month within the 1-12 months category. The total N excreted in the 0-12 month category is 21kg for both males and females and 55kg and 61kg in the 12 to 24 month category for females and males. Similar trends are observed for phosphorous. These differences suggests that there are small differences between males and females in the 12 to 24 month period for this analysis. However if they are to be kept together the average of the male and female categories will result in an organic N figure of 58kg of N and an excreted P value of 9kg.

Reference

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