

Steps to improving farm N use efficiency

Shinagh Estates Dairy Farm, Bandon, Co. Cork

Kevin Ahern, Farm Manager & John McNamara, Teagasc Advisor

Introduction

Kevin Ahern manages Shinagh Dairy Farm milking 250 cows in a spring calving system. The farm is part of the Farm Zero Climate (FZC) programme run by Biorbic, Carbery and Teagasc and funded by Science Foundation Ireland (SFI).

The farm was set up in 2011 by converting a beef farm to dairy at a cost of €850,000 including stock. It is leased from Shinagh Estates Limited which is owned by the west cork co-ops Bandon, Barryroe, Drinagh and Lisavaird. It achieved its initial objectives to make a return on all the factors involved: land lease, labour, loan repayments. It is a very profitable farm business. Over the last number of years, there has been a major focus on the farm to improve farm sustainability and reduce farm emissions without compromising on profit. A number of areas have been addressed from optimising soil fertility, making better use of slurry to reducing overall farm chemical N use through increased N fixation by clover.

The farm

The farm consists of 102ha in total including leased ground. There is 84ha available to graze by the milking herd, the rest is outside ground used for silage and grazing with dry cows and in calf heifers in the autumn. There were 242 cows milked in 2023. The herd is mostly crossbred Friesian / Jersey cows with some Norwegian Red influence too. Its EBI is 257. Kevin Ahern is the farm manager and main labour assisted by a second in command, Eoghan Ahern currently, with student labour in spring for the calving season.

Grass & Fertiliser

12.15 tonnes of grass dry matter was grown in 2023 using 114kg/ha of artificial nitrogen (N), 20 kg / ha of artificial phosphorous (P), and 62kg / ha of artificial potassium (K). The farm organic stocking rate was 224kg/ha, and the herd is in Band 2 for nitrates (92kg of organic nitrogen / cow). That is an overall farm stocking rate of 2.5cows/ha and a milking platform stocking rate of 2.9cows per hectare.

Calving & Breeding

It is a spring calving herd with an EBI of €257. The planned start of calving is the 7th of February and 90% of the herd were calved in 6 weeks in 2023. Half the herd was calved by Feb 21st. It is a fertile herd with a calving interval of 362 days last year. There was a 98% submission rate in the first 3 weeks of breeding and just 9.2% of the cows were not in calf after 11 weeks of breeding. The cows have movement monitors on them these are used for heat detection. All breeding is now by AI, with no stock bulls used on the cows. The replacement heifers are contract reared by a local farmer and leave the farm at two weeks of age and return as in calf heifers in November prior to calving in the following February. All heifers' calf down between 22 and 24 months of age.

Herd Performance

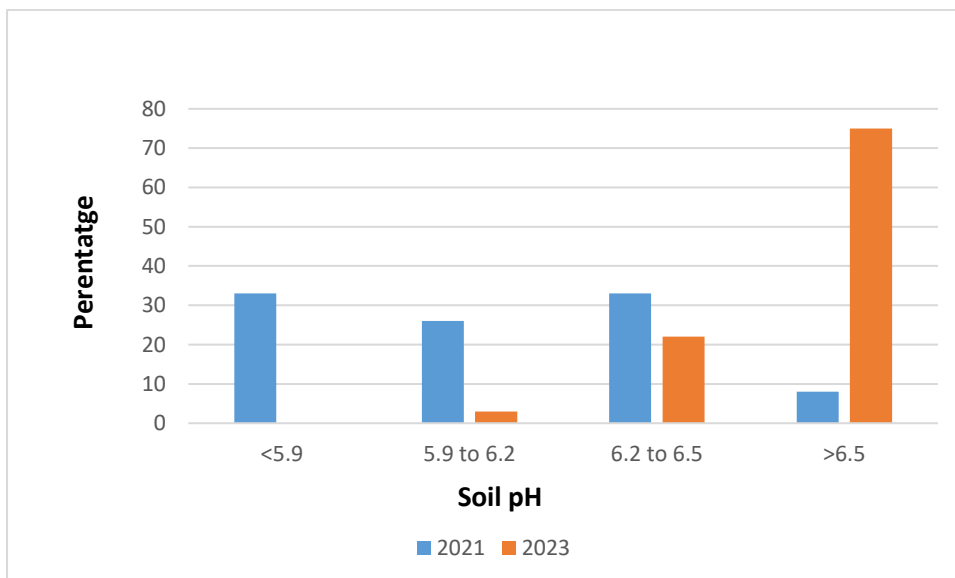
The herd supplied 5,264 litres of milk to Bandon Co-op in 2023 at 4.68% Fat and 3.76% Protein. This is 458 kg of milk solids supplied per cow. Average stomatic cell count (SCC) was 171,000 and TBC was 9,000. 876 kg of ration was fed per cow.

Farm Soil Fertility

Building soil fertility has been a key priority over the last number of years. Since 2021 the farm has moved to annual soil sampling to monitor soil fertility changes; the farm nutrient management plan is updated each year to reflect new soil test results.

Soil pH & Lime

In 2021, soil test results showed that 66% of soils had a lime requirement with 59% of soils pH 6.2. Lime was applied over the last 2 years and soil pH levels show that 97% of soils are optimum (>pH 6.3) as shown below in figure 1. Correcting soil pH is the first thing to get right at a very low cost and will increase the recycling of soil N supply throughout the growing season. It will provide the optimum soil conditions to make best use of applied nutrients in either the organic or chemical form.



Soil P & K

Soil P and K levels were relatively good as shown in figure 2 and 3 below. There is a low percentage of soils testing at P index 1 and 2 while the majority of soils are testing at Index 3 and 4. Over the last 2 years soils at P index have reduced from 53 to 31% which is positive and shows the value of soil tests on nutrient distribution around the farm. Today there is 50% of soil at the agronomic optimum Index 3 on the farm.

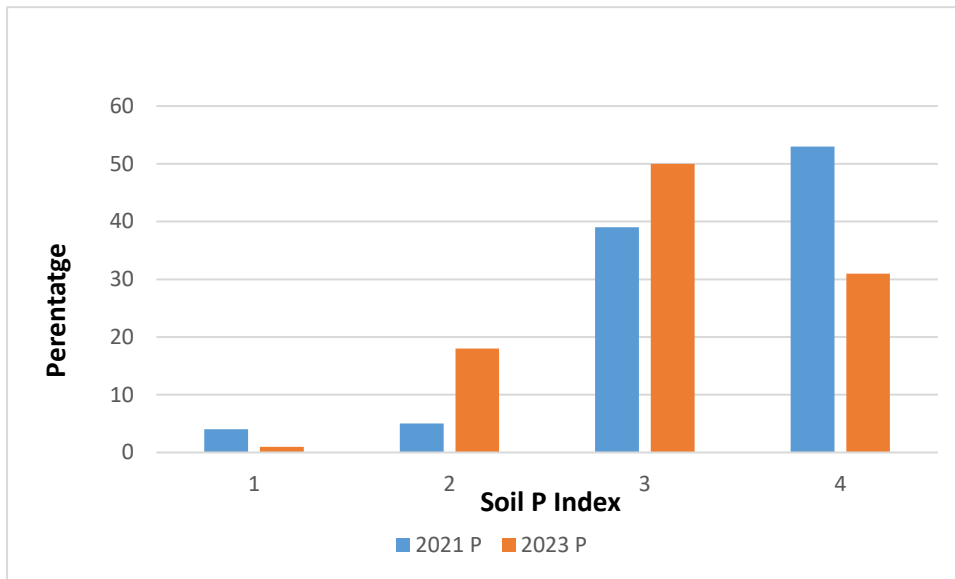


Figure 2:- Percentage of soils on the Shinagh farm at different soil P Index (1 to 4) from 2021 to 2023.

There is a low percentage of soils testing at K index 1 and 2 which is very typical of many Irish soil types in 2023. The majority of soils are testing at K Index 3 and 4 with a different trend than P where soils at K index 4 have increased from 31 to 61% over the last 2 years. This is an asset especially on the grazing parts of the farm and shows that nutrients in cattle slurry can be diverted to other areas of the farm for example soils at K index 2 to ensure a better farm nutrient balance.

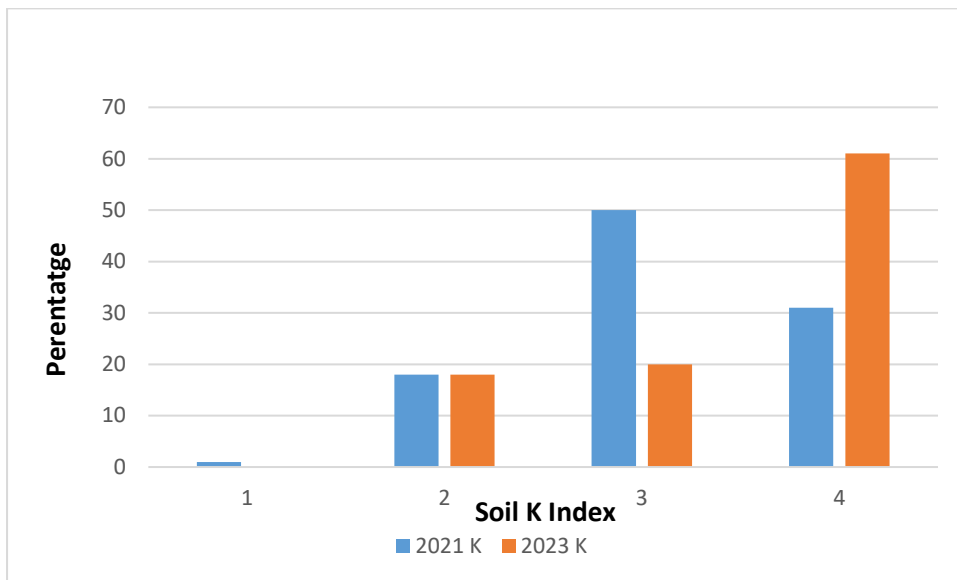


Figure 3:- Percentage of soils on the Shinagh farm at different soil K Index (1 to 4) from 2021 to 2023.

Optimum Soil Fertility on the Farm

Since 2021 soil fertility has improved from 18% to 60% from the correction of soil pH through targeted lime applications. Correcting soil pH will increase the soil supply / efficiency of both P and K, especially P and effective management of these nutrients during this period brought much savings in the purchase of these two major plant nutrients.

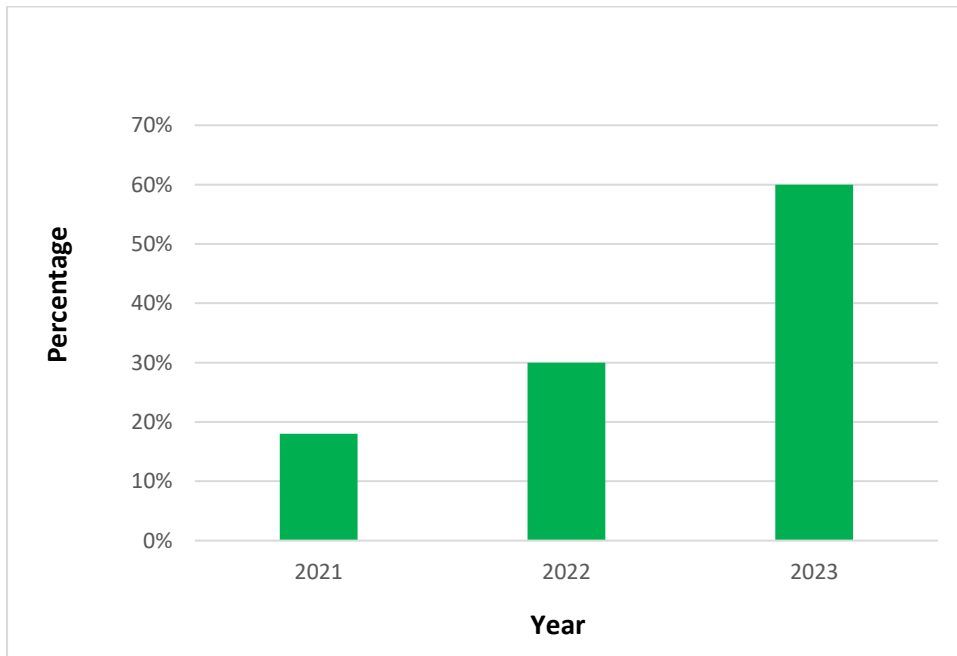


Figure 3:- Percentage of soils on the Shinagh farm with optimum soil pH, P and K from 2021 to 2023.

Optimising soil fertility levels delivers many benefits from improving farm N use efficiency to providing the basis for clover establishment and productivity. The target in the Signpost programme is to optimise 85% of soils to optimum soil fertility. This

will be achieved by moving soils out of Index 1 and 2 for both P (29%) and K (18%). Soil sampling will continue on an annual basis to monitor soil fertility levels and ensure optimum use of applied nutrients as either organic manures or fertilisers.

P & K Fertiliser Management

In 2024, the aim will be to correct any remaining soils at P and K Index 1 or 2 through targeted application of nutrients as per the nutrient plan. Soils at Index 3 will be maintained through appropriate nutrient applications. Soils at P and K Index 4 will only receive N and S and further draw down soil P and K reserves. Index 3 is the sustainable P and K Index for both productivity and environmental quality. This shows the value of soil testing on a regular basis to optimise soil fertility levels depending on soil type around the farm.

Farm N Use Efficiency

Farm data would show that over the last number of year's soil N use efficiency has increase from 31.5% in 2021 to 51.6% in 2022. Good soil fertility would be the foundation to improving farm N use efficiency in combination with the rate of N applied. Increased incorporation of clover reduces farm chemical N requirements thus improving farm N use efficiency.

Reducing chemical N use by 45%

All farmers are being asked to reduce their reliance on chemical N and switch from using CAN and straight urea to protected urea. Kevin was reluctant in engaging with part 1 of this objective initially. He was very nervous about cutting N by 30%+ while at the same time maintaining grass grown on the farm and not having to resort to buying in additional feed to make up a potential shortfall in grass grown.

But this has been a good news story. Chemical N has been reduced by 45% or from 207 kg N / ha in 2020 to 114 kg N / ha in 2023. While at the same time, grass grown in 2023 is 12.2t DM / ha down just slightly on 13.4t DM / ha grown in 2020. Growth was lower in 2022 at 11.7t DM due to a severe drought.

Multi species swards

Each year since 2020 a paddock has been reseeded using a multispecies mixture. This mixture consisted of perennial ryegrass, clover, plantain, chicory. They have performed very well and are some of the highest yielding paddocks on the farm. These are the paddocks with the highest clover content. The clover has thrived in these low nitrogen application paddocks. The plantain and chicory has decreased in content each year.

Clover

Clover is the main driver of the reduction in chemical N use on this farm. We started with trying out clover in some paddocks and got confidence in it when we could see what it could do in terms of replacing artificial nitrogen. We encouraged the clover by backing off applying N over the summer to these paddocks so that we could see what the clover could do. They matched neighbouring paddocks that were getting

their full complement of artificial nitrogen. The clover paddocks did get soiled water during the season. Initially these paddocks got nitrogen in spring for the first two rounds until Mid-April. In 2022 one paddock got no nitrogen for the full year and in 2023 this was increased to three paddocks. The performance of these paddocks has given us the confidence to try this approach on more paddocks in 2024.

Clover has been increased on the farm through a combination of reseeding and top seeding clover into existing grass swards. I think top seeding has about a 30% chance of being a success and very much depends on having the paddock well grazed off before applying the seed, damp weather afterwards to ensure the seed germinates, and then grazing the paddock for the next 2-3 times at very low grass cover in order to prevent the grass shading out the tiny clover plants. Full reseeding at a 2kg of clover bare seed per acre seeding rate is a surer way of getting a successful result. This has been employed on the low yielding grass paddocks as they require reseeding.

At this stage 60% of the farm has a clover content of at least 15%. The silage ground that is not on the grazing block has been reseeded to a red clover and grass mixture. This only gets slurry and artificial P and K. It gets no chemical nitrogen.

Below is a table showing the different amounts of chemical nitrogen applied to paddocks in 2023 and their grass yield. The high clover paddocks tend to be the newer reseeded paddocks.

Table 1. Chemical N Application and Grass Grown for High, Medium and Low Clover Paddocks

Clover Content	Chemical N (kg/ha)	Grass Grown (kg DM/ha)
High Clover	0	12.44
High Clover	21 kg in Spring only	11.00
High Clover	62 kg in Spring only	11.76
Low to Medium Clover	182	12.55

Conclusion: High clover swards can match high bag nitrogen swards in grass grown.

Red Clover

We reseeded the first of the outside silage ground to a red clover / grass mixture in Sept 2021. It struggled to compete with chickweed the first winter and spring. Against all advice it was grazed in late autumn with in calf heifers and again the following early spring very carefully with late calving dry cows. The animals were grazing it on/off and being put back in the nearby house when conditions were not suitable. Poaching was kept to a minimum. The grazing solved the chickweed problem and this field has gone on to produce good yields of silage in 2022 and 2023. A further silage field was reseeded to red clover / grass mixture in 2023. These fields get no artificial nitrogen. They get the necessary amounts of P and K from slurry before and after each silage cut. They will also get straight P or K if there is not sufficient slurry available. These fields are matching the conventional silage paddocks, that get a full allowance of chemical nitrogen, in yield. It has given three

cuts of silage and one zero grazed cut in 2023, and there is a final zero graze cut that is waiting until ground conditions allow to be taken.

Slurry

All slurry is applied to the land by a contractor using a low emission tanker (LESS). No slurry gets applied until February, when it will go on 25% of the grazing area. It is used on the paddocks that were first to be grazed in March. Then all silage ground will get an application before first cut silage. The farm is getting to the point that there isn't enough slurry on the farm! I am minding the slurry to apply to the red clover after each cut. This means holding slurry to apply after the September silage cut. The farm has invested in extra tanks to make sure that valuable nutrients in the soiled water produced in November is available for spreading in spring.

Avoiding waste

All fertiliser on the Shinagh farm is spread by contractor. The contractor uses GPS equipment. There will be no overspreading just to empty the spreader, as the accuracy of the GPS equipment ensures this does not happen. Fertiliser manufacturers report a 10% savings in fertiliser use from GPS spreading.

Protected Urea

Protected urea has been used since 2018. Initially the reason was it was cheaper than CAN per unit of nitrogen. When we got more environmentally conscious we know that is better for the environment than either CAN or straight Urea. The cost of the protection is offset by it being more efficient and one can use slightly less of it for the same grass growth. However, there is a need for more Urea compounds with P and K. We have found ourselves having to use straight super P (16% P) and Muriate of Potash (50% K). The only compound fertilisers used now are 10:10:20 for reseeding.