

Soil and Nutrient Network



National Advice Hub
T: 0300 323 0161
E: advice@fas.scot
W: www.fas.scot

Helping farmers improve soil and nutrient management

Case study - Limekilns Farm, Dumfriesshire

Limekilns is a dairy and arable unit farmed by Alastair Crichton and his family. The farm is predominately grassland extending to 194 hectares and is located on the outskirts of Annan, Dumfries and Galloway. The cropping enterprise includes 80 hectares of cereals which consist of spring wheat, winter barley, spring barley and forage rape. The remaining 114 hectares are split between permanent and temporary grassland. Approximately half of the cereal crops are whole-cropped and ensiled with the remainder being combined and crimped for feeding. The farm carries 223 high yielding Holstein Friesian dairy cows which graze during the summer.

Limekilns sits 85ft above sea level with the majority of the farm having a mineral gley soil type. According to the land capability for agriculture classification system, most of the land comprises of grade 3.1 and 3.2 land. This type of land is capable of producing high yields of crops such as cereals and grass. The farm lies within the river Annan catchment area which has recently been designated a priority catchment by SEPA.

Soil Structure

At Limekilns three cuts of silage are taken on 70 hectares. This can involve taking cuts of silage when field conditions are not always suitable to be supporting heavy machinery. As a result soil compaction can occur, limiting crop yield.

During the first Soil & Nutrient Network Meeting in July 2017, SAC soil specialist Paul Hargreaves examined the soil structure by digging a deep soil pit in one of headlands of a main silage field, where most of the machinery travels. It could be seen there was a layer of deep compaction which was 30 cm deep. The signs of compaction were hard blocky type aggregates with horizontal fissures.

Near the centre of the silage fields the soil structure appeared much better with the soil having much smaller aggregates which crumbled in the fingers. This is an ideal soil structure for allowing for easy root penetration and passage of water through the soil profile, optimising crop yield.



A sward lifter demonstration was used to show how compaction problems can be mechanically removed between 20 – 30cm soil depth. Following an assessment of the silage fields, the business has decided to use a sward lifter in any fields showing signs of compaction.

On the day a sward slitter was also demonstrated to show how it can remove shallower surface compaction. This machine is best suited for removing surface compaction down to 10cm in depth. Fields that were found suitable for this machine included grazing fields that had been poached during the previous autumn by cattle grazing in wet conditions.



For more information on the Soil and Nutrient Network see www.farmingandwaterscotland.org. For dates of SNN events, find us on Facebook or follow us on Twitter @FarmWaterScot.



Scottish Government
Riaghaltas na h-Alba
gov.scot



The European Agricultural Fund
for Rural Development
Europe investing in rural areas

Soil and Nutrient Network

Soil Analysis and Liming

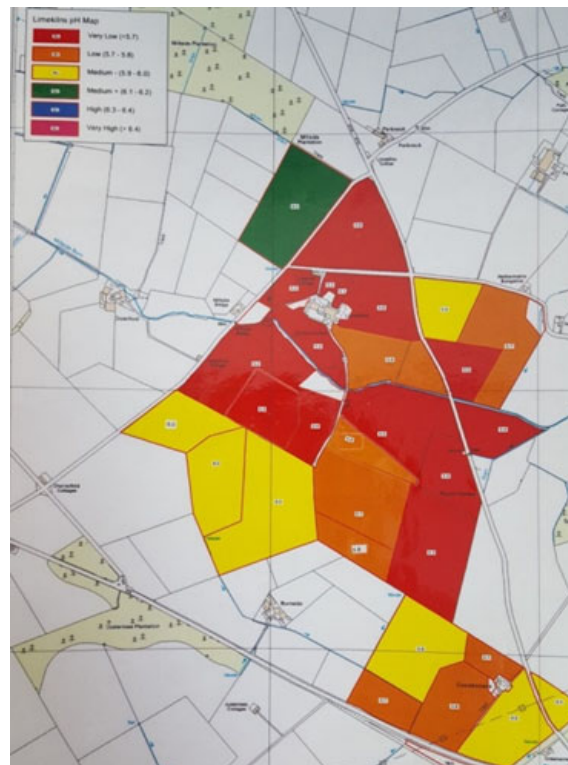
Prior to the first nutrient network meeting, Limekilns was conventionally soil sampled and analysed for pH and major nutrients. The farm was found to have a low pH level with an average pH of 5.8 across the farm.

At the first meeting SAC consultant & agronomist Donald Dunbar explained the importance of analysing soil and rectifying low pH levels with lime.

Donald explained how soil acidity below pH 5.6 in Scotland causes aluminium toxicity to cereals and inhibits root growth and yield. By getting soil pH at an optimum level essential plant nutrients such as nitrogen, phosphorous, potassium, sulphur, calcium and magnesium will become more available to the plant, with the potential to increase yields.

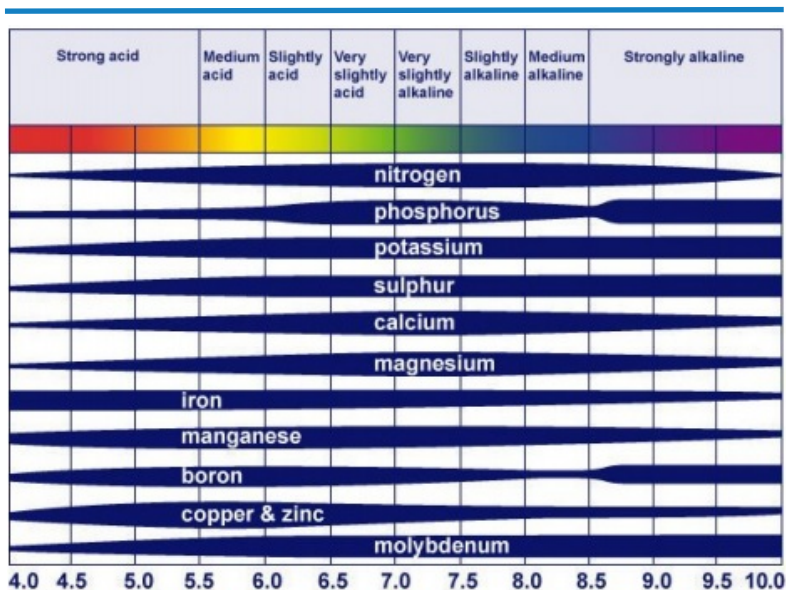
Donald also stressed the importance of not over liming as trace elements such as, manganese, boron, copper and zinc can become less available. Lime can also lock up soluble phosphate (as calcium phosphate) making phosphate unavailable to the plant. Lime applications should be limited to no more than 7.5t/ha on established grassland and when there is only minimal cultivations. When up to 10t/ha is required half should be deeply cultivated into the soil and ploughed down with the remainder being applied on the surface and worked in.

Due to the cost of correcting the pH at Limekilns, a five year liming plan has been created. The plan is to target cropped fields and grassland fields with lowest pH first. Lime will be applied to the grazing fields and spring cropping fields in the spring, with the winter sown crops and silage fields receiving lime in the autumn. The overall aim at Limekilns is to increase the productivity and yield of arable crops and grassland crops over the next five years.



Limekilns pH Map. Red (low <5.7) to Purple (High >6.4)

pH limits the availability of other nutrients



Rogues, S; Smith, K A; Newell Price, P & Berry, P.M. (2003) Review of the non-NPKS nutrient requirements of UK cereals and oilseed rape, HGCA is the cereals and oilseeds division of the Agriculture and Horticulture Development Board. (<https://goo.gl/Unfjm3>)

Valuing Your Soils

Your soil is the farm's most important asset. Correct management can improve overall farm productivity and profitability.

The Valuing Your Soils booklet has been produced to provide practical guidance to Scottish farmers. Full of tips and ideas, case studies and simple, practical guidance, this booklet is available for free to download from the [Farm Advisory Service](#) website.



Soil and Nutrient Network

The Value Of Home Produced Nutrients

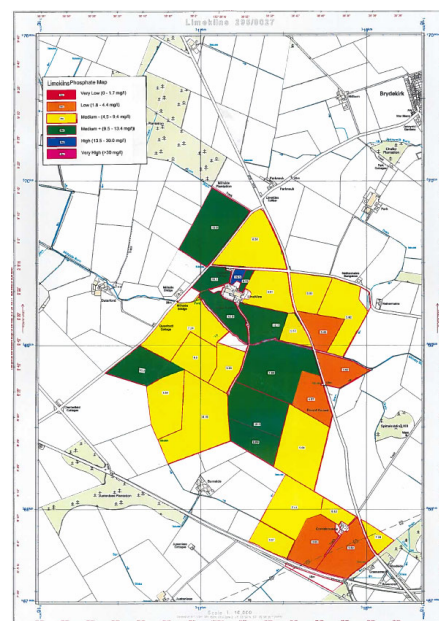
As a split dairy / arable unit comprising of approximately 223 high yielding Holstein Friesian cows supported by 114 hectares of grassland and 80 hectares of cereals, there is both a high level of demand for, and production of, nutrients at Limekilns.

Whilst the business currently produces high volumes of slurry and farm yard manure (FYM), all of which are utilised on the land at Limekilns, farmer Alastair Crichton is aiming to get the most out of home produced manures whilst also reducing fertiliser costs where possible.

In March 2018, soil sampling results were obtained to help prepare whole farm fertiliser plans. The farm map is shown right, illustrating soil P status as derived from the soil sampling exercise. Five fields were identified as being 'Low' in P, whilst nine fields were identified as being either 'Low' or 'Very Low' in K.

As a result of these findings, Alastair Crichton is now proposing to increase the number of slurry and FYM applications to the fields that previously did not receive any significant quantities of organic manure.

Calculations have been used to demonstrate some of the savings that should be possible. The financial value of slurry at Limekilns is calculated in the tables below, based on current fertiliser prices and standard level of nutrients available from slurry.



Limekilns – Phosphate Map

Fields with Low phosphate status shown on the map in orange.

Table 1. Standard nutrient value and potential value of cattle slurry

Slurry Nutrient Content and Value (Cattle slurry – typical - 6%DM)			
	Total	Readily available	Potential value £/t
Nitrogen (N kg/t)	2.6	0.91 (35% of total)	£0.74 (crop available N)
Phosphate (P ₂ O ₅ kg/t)	1.2	0.72 (60% of total)	£0.55 (total P ₂ O ₅)
Potash (K ₂ O kg/t)	3.2	2.88 (90% of total)	£1.38 (total K ₂ O)
			Total (£2.67/m ³)
Based on current fertiliser prices: N 81p/kg; phosphate 76p/kg; potash 48p/kg (These prices* are based on: AN (34.5% N) @ £230/tonne, TSP (46% P) @ £350/tonne, Potash (60% K) @ £280/tonne)			
1 million gallon store = £12,136			

*Fertiliser prices correct at 7 January 2019

Given the herd of 223 high yielding dairy cows at Limekilns, slurry production for a 180-day winter housing period can be estimated at 1,926m³ using Planet Scotland software (www.planet4farmers.co.uk). Based on the fertiliser values shown in table 1, the slurry from the 223 high yielding cows may be worth in the region of £5,142.42 when all nutrients are considered.

Table 2. Calculating the financial value of slurry at Limekilns

Calculating the Financial Value of N, P & K in Slurry at Limekilns
Slurry production from 223 high yielding dairy cows housed for 180 days estimated at 1,926m ³
Using the financial value of slurry as calculated in table 1:
£2.67/m³ x 1,926 m³ = £5,142.42

Soil and Nutrient Network

GPS Soil Sampling

The third and final Soil & Nutrient Network meeting at Limekilns was held during December 2018 and aimed to highlight some of the potential benefits of employing GPS soil sampling.

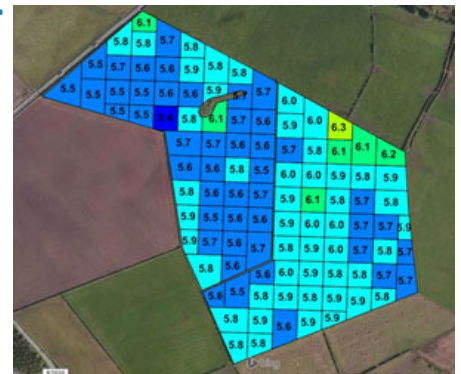
Prior to the meeting, four fields were sampled for pH at 4 samples per hectare with routine samples being taken for analysis of P & K. One field was zone sampled for P & K.

SAC Consultant David Ross delivered a presentation which described the procedure for GPS soil sampling, reviewed the GPS sampling results from Limekilns and went on to describe some of the equipment used when collecting GPS soil samples.

During his presentation, David explained that one of the main reasons for using GPS soil sampling was to reduce in-field nutrient variation and also to reduce crop variability within individual fields. For example, by identifying high and low pH patches within an individual field, farmers can employ variable rate lime spreading to help level out the pH imbalances and give rise to reduced variability in crop yield.

The same principle applies to assessing nutrient levels such as P, K, Mg & Ca. Whilst routine sampling produces a single result for each nutrient in each field, fields can also be split, or zoned, in order to produce multiple results per field. This may be appropriate where two fields are now merged but have different soil types and different cropping histories. This approach can be taken further still by obtaining 1 sample per hectare for the analysis of P, K, Mg and Ca but the cost of analysis does increase as more samples need to be processed.

At Limekilns, the use of GPS soil sampling did not produce any savings with respect to the quantity of lime proposed for application in 2019, however, savings in P & K were identified within the single field which was sampled at 1 sample per hectare.



GPS sampling: pH map – Field 1



GPS sampling: Nutrient map, Field 1, Zoned for P & K

Key Findings

- The main threats to soils include: compaction, erosion, loss of organic matter.
- Use the VESS assessment of field areas where there is concern about soil compaction to assess the severity & depth of any problem. This will allow the correct management decision for the equipment to use: compaction at the surface (0 – 15cm) – slitter; deeper compaction (15 – 35cm) – sward lifter.
- Know your soil nutrient values - regular soil testing to manage soil pH will ensure that soil nutrients are available for crop uptake.
- Consider GPS soil sampling to reduce in-field nutrient and crop variability within individual fields.
- When comparing liming products check the declared Neutralising Value (NV) - this indicates the speed & effectiveness of the liming material. Also check the declared particle sizes of the material, fewer larger particles are more desirable.
- Compare the cost per unit of NV by dividing the cost per tonne (delivered & spread) by the NV of the product.
- Don't underestimate either the nutrient or financial values of home produced organic fertilisers. Testing your slurries and FYM prior to application will allow you to accurately calculate application rates & the financial values of these applications over purchased fertilisers.
- Consider using a nutrient management software such as PLANET Scotland (www.planet4farmers.co.uk) to keep accurate field records to improve nutrient use efficiency.
- Keep up to date with Scotland's Soil & Nutrient Network to find out what management measures other farmers are benefitting from. Find out more from the website: www.fas.scot/soil-nutrient-network-host-farms/