Soil and Nutrient Network

Helping farmers improve soil and nutrient management

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Case study -
Balnellan Farm, Moray

Balnellan fam is an upland farm located at Maggieknockater west of the town of Craigellachie in Morayshire. The farm is a mixed upland farm rising from approximately 140m to 200m above sea level. The main farm consists of 148 ha across three blocks of neighbouring land with another 142 ha of land seasonally rented within the surrounding area. The main enterprise on the farm is a herd of 170 suckler cows of mixed breeds put to a selection of bulls (Aberdeen Angus, Limousin, Salers and Shorthorn). All herd replacements are kept on farm with the rest of the calves sold as stores or finished at 18 to 22 months of age.

Most of the land on the main farm is grass with the majority of the rented land in cereals. The farm grows approximately 150 ha of cereals, 48 ha of silage and hay with the remaining 92 ha used as grazing grass. The farm produces slurry and FYM from the cattle and imports digestate and distillery sludge which are all used on the farm to reduce purchased chemical fertiliser.

Balnellan Farm - Nutrient Status

The farm has carried out regular soil analysis. The current soil status is shown in Table 1.

The results of the analysis indicate that The results of the analysis indicate that all bar one of the fields are on or above target for pH, as field 8 is below target for spring barley at 5.8. 37% of the fields are below target for Phosphate, For Potash, only 2% of the fields are below target but 48% of the fields are above target. All the fields except one are on target for magnesium.

Table 1

Field	Crop	pH	Phosphate	Potash	Magnesium
1A	Silage	5.8	L	M+	M
1B	Grazing	5.8	L	M-	M
2A	Grazing	6	L	M+	M
2B	Grazing	6.1	L	M-	M
4A	Silage	6	M-	M-	M
4B	Silage	6	L	M-	M
5A	Silage	6.3	L	M-	M
5B	Silage	6.3	L	L	M
6	Grazing	63	L	M-	M
7	Grazing	6.3	M-	H	M
8	Sp Barley	5.8	M-	H	M
9	Grazing	6.5	M-	H	M
10	Grazing	6.2	M-	H	M
11	Grazing	6.6	M-	H	M
12	Grazing	6.4	M-	M-	M
13	Grazing	6.2	M-	H	M
14A	Sp Barley	6.1	M-	H	M
14B	Sp Barley	6.3	M-	H	M
15	Grazing	6.1	L	H	M
16A	Silage	6.2	M-	M-	M
16B	Silage	6	M-	L	L
17	Silage	6.4	M-	M-	M
18	Grazing	6.5	L	M-	M
19	Grazing	6.5	M-	M+	M
20	Silage	6.7	M-	M-	M
21	Silage	6.4	M-	M-	M
22	Grazing	6.3	M-	H	M

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Organic nutrient benefit

The farm produces both FYM and slurry, which are a valuable nutrient resource for the business. Table 2 shows the FYM production and slurry production.

Table 2

Balnellan Livestock Organic Manure Production		
Livestock Type	**Number Housed**	**FYM produced (m^3) or Tonnes**
Suckler cows with calves	35	648
Dry cows	120	1925
Cattle 14 – 18 mths	78	704
Livestock Type	**Number Housed**	**Slurry produced (m^3) or Tonnes**
Cattle 10 – 14 mths	80	302
	Total	**3579**

The quantity of organic manure produced has a nutrient content. In addition to the organic manure produced on the farm approximately 1,500 tonnes of digestate is imported which also has a nutrient benefit. Table 3 shows the total nutrient value of the organic manure used on the farm.

Table 3

	Nutrients produced (Kg)		
	Total N (Kg)	Total Phosphate (P_2O_5) (Kg)	Total Potash (K_20)
Nutrients in FYM	18,059	10,554	27,203
Nutrients in Slurry	366	333	1,179
Digestate	11,700	5,880	3,315
Total (Kg)	**30,125**	**16,766**	**31,698**

Unfortunately not all the nutrients are available while almost all the Phosphate and Potash will be available eventually only 50 to 60% of the Phosphate and 80-90% of the Potash are available in the year of application. Nitrogen is more complex and depending on the type of material and the time of application the amount of Nitrogen available to the crop can vary from between 5 and 55%. Based on achieving the best management for the type of manure Table 4 shows the available nutrient value and the potential economic value based on fertiliser pries in early 2019.

Table 4

	Nutrients produced (Kg)		
	Total N (Kg)	Total Phosphate (P_2O_5) (Kg)	Total Potash (K_20)
Available Nutrients in FYM	1,806	10,554	27,203
Available Nutrients in Slurry	165	333	1,179
Available Nutrients in Digestate	6,435	5,880	3,315
Total Available Nutrients (Kg)	8,406	16,766	31,698
Nutrient Value (£/Kg)	0.82	0.75	0.48
Total Value (£)	**£6,893**	**£12,575**	**£15,215**

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Grass quality results from different organic manure applications

Our third meeting at Balnellan focused on grassland management. One aspect of productive grass growth is nutrient management. As part of the project, grassland samples for analysis were taken from fields at Balnellan comparing grass, all from one field that had had digestate, the farms slurry mix and no organic manure. All the grass had 125kg/ha (1cwt/acre) of 32% Nitram. The results are shown in Table 5.

Table 5

Field	Slurry treated	Digestate treated	No treatment
Ash %	7.3	7.6	6.9
Dry Matter %	20.3	20.4	21.0
Crude Protein %	14.2	16.8	20.2
Fibre %	25.3	25.2	26.9
Sugar %	18.7	16.9	11.5
D Value %	72.7	72.8	71.1
Metabolisable Energy MJ/kg	11.5	11.5	11.2
P %	0.36	0.39	0.42
K %	2.54	2.56	2.29
S %	0.17	0.18	0.15
Mg %	0.11	0.12	0.12
Ca %	0.4	0.45	0.41
Na %	0.02	0.02	0.02
Mn mg/kg DM	41.8	38.4	35.0
Co mg/kg DM	0.02	0.04	0.06
Mo mg/kg DM	1.15	2.31	1.89
Fe mg/kg DM	41.0	46.2	43.2
B mg/kg DM	4.4	4.9	5.6
Cu mg/kg DM	6.6	6.8	5.9
Zn mg/kg DM	19.7	20.8	19.7
Se mg/kg DM	<0.02	0.03	<0.02

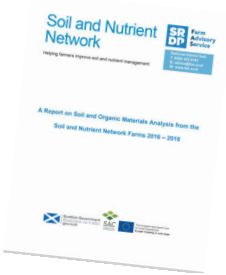
There area couple of results worth noting. Firstly, the crude protein level. It was significantly higher in the grass/clover that had received no organic manure and only the low level of fertiliser. It is thought that the slurry and digestate were affecting the clover growth. This was borne out on visual inspection with the swards with the slurry and digestate treated areas having much lower clover densities. It should be noted however that the yield in the untreated areas was much lower.

Two possible explanations are that the extra nitrogen in the slurry and digestate encouraged grass growth at the expense of the clover. There was a suggestion that the digestate (and possibly slurry) is causing scorch of the clover leaf. Further investigation would be beneficial and it is suggested that a visual inspection of the clover be carried out following future applications of slurry or digestate. In addition, checking the salinity level of the materials being applied should be checked because this will give an indication of the scorching potential.

The second point to note is that of the sulphur levels. The results show that the sulphur level is lower than would normally be anticipated - normal results would be within the range of 0.2% and 0.5%. There is less sulphur in the atmosphere now so choosing a fertiliser containing sulphur is recommended.

Could the pH of your soils be affecting your production?

All the Soil & Nutrient host farms have their fields soil sampled for analysis as part of the three year project.



We've published a report that has found that from a study of 273 of these soil samples from around Scotland during 2016-18, almost half had a pH below 5.8 (the optimum pH range is 6.0 - 6.2 in mineral soils to improve nutrient availability & crop yield).

A link to the full report is available from our Soils webpage at

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Grassland management

SRUC's Grassland Agronomist, Dr David Lawson, gave us some top tips for grassland management during our final meeting.

1. **Refer to the Scottish Recommended List before choosing a grass and clover seed mixture** The varieties of ryegrass and clover in the list have been tested at three stations in Scotland. Moreover, winter hardiness measurements are carried out at Clashnoir in Banffshire and it is worth checking that any grasses chosen have a good winter hardiness value. It is also worth noting that many of the grasses that enter the Recommended List for England and Wales do not achieve recommended status in Scotland.
2. **Grassland can capture significant amounts of carbon in the soil, particularly under long term pasture**. Planting of forests is often seen as the main way of capturing carbon, but long term grassland is actually as effective as forestry, and more effective than arable crops at immobilising carbon within the soil organic matter. Grasses with more extensive root systems will produce greater amounts of soil organic matter. For instance Diploid varieties of Perennial ryegrass produce more root material than Tetraploid varieties.
3. **Soil organic matter provides the main reserve of plant nutrients, particularly Nitrogen.** The reserves of nitrogen are released for grass uptake by soil bacteria. These are only active when the soil is warm and has significant moisture content. This is normally in spring and autumn. Therefore the availability of soil nitrogen is greatest at these periods and a natural boost in grass growth will be observed. However, this increased availability of nitrogen takes place whether or not there is a crop present. Thus during mild periods in winter bacterial activity will release available nitrogen from the soil organic matter. If there is no grass or crop present to take this up then it will be leached as nitrate from the soil.

Key Findings From Balnellan

- You need to monitor your soil to manage them - get to know the structure, pH and nutrient values
- Use a spade to identify soil structure and identify any problems. Knowing the problem *and* the depth is essential before choosing how to remedy it
- Any remedial action should be timed during good weather and soil conditions - don't make the problem worse, or create others
- Use gravel back fill on drains, particularly in heavy soils to ensure effective field drains
- Check soil pH status regularly - testing between 3-5 yearly is ideal
- If pH is below optimal levels, plan cropping rotations carefully to reduce production losses
- Allow time (up to 2 years) from lime application to allow lime to be fully active
- Earthworms are a good indicator of the health of the soil - both for nutrients and structure
- The more diversity within the soil the healthier the it is; healthy soils support good crop yields
- Organic manures and fertilisers are key to increasing soil biodiversity, but beware not to over apply them - this can be detrimental to crop growth and the environment
- Test your organic manures before you spread - having this information ensures you can meet crop nutrient requirements and top up with inorganic fertilisers efficiently and critically allows you to know the benefit of any imported organic manures.
- Make use of the free to download and use nutrient management tool at www.planet4farmers.co.uk
- Before choosing a seed mixture ensure that the grass and clover varieties are on the Scottish Recommended List
- Grassland can capture significant amounts of carbon in the soil, particularly under long term pasture
- The carbon is held within the soil organic matter. It also provides the main reserve of nutrients, particularly Nitrogen
- The types of grass and clover sown can influence the quantity and quality of the soil organic matter

Meeting notes summarising all of the events held at Balnellan are available at www.fas.scot where you can also find out more about the other Soil & Nutrient Network host farms.