Natural England Research Report NERR073

The Soils for Profit Project

www.gov.uk/natural-england

Natural England Research Report NERR073

The Soils for Profit Project

Steve Marston

Published 11th April 2018

ISBN 978-1-78354-470-7

Project details

This report should be cited as: MARSTON, S. 2018. *The Soils for Profit Project.* Natural England Research Report Number 073.

Acknowledgements

This report has been written by Steve Marston, who managed the project between 2009 & 2014, with input from:

- Sean Mahoney, S4P Assistant Project Manager,
- Bob Middleton, Natural England Project Manager of Catchment Sensitive Farming and Chair of the S4P Steering Group,
- Phil Shere, Principal South West Agriculture Officer, Environment Agency and member of the S4P Steering Group,
- James Grischeff, former National Senior Adviser - Catchment Sensitive Farming
- Gill Shaw, Senior Environmental Specialist – Soils,
- Nigel Simpson, River Basin Co-ordinator, Catchment Sensitive Farming,
- Thomas Harle, Senior Economist, Natural England.

Many of the graphs and figures contained in this report were produced by Becky Wilson from the SWARM Hub, Duchy College Rural Business School, Cornwall using S4P data. (As many S4P staff were employed on fixed term contracts, ending on 31 December 2013, it was important to get this data analysed before that date, therefore many of the graphs and figures found in this report show S4P delivery up to 30 September 2013 where as some aspects of project delivery continued until 31 December 2013).

Project manager

Steve Marston
Natural England
Bridgewater
Rivers House Bridgewater
East Quay
Bridgewater
TA6 4YS
steve.marston@naturalengland.org.uk

Contents

1 Summary

Background

This report describes and reviews the background and objectives of the Soils for Profit (S4P) Project, its relationship with other initiatives and how the project was delivered.

S4P ran from 2009 to 2013 with the aim of helping farm businesses manage their soils, manures and nutrients more efficiently; improve farm profitability and benefit the environment. Environmental benefits included reducing agricultural pollution, conserving soils and increasing farm and landscape resilience to climate change.

The project was delivered in the counties formerly known as the South West Region - Cornwall and Isles of Scilly, Devon, Somerset, Dorset, Wiltshire, Avon and Gloucestershire. This area amounted to approximately 10% of the UK and 20% of England (Wikipedia 2017). According to Defra in 2013 the economy of the South West Region was more reliant on agriculture than any other English region. During 2011 agriculture contributed 1.25% to the region's economy and 2.22% of all jobs in the area, which was nearly twice the percentage for England - 1.14%) (Defra 2013). Annual average farm business income in the region was lower than the national average by over £14,000. (Defra 2013).

One third of the South West Region was designated for its landscape quality (National Parks & Areas of Outstanding Natural Beauty and almost a quarter of all the country's Sites of Special Scientific Interest were located in there. 8% of the region was classified as Less Favoured Area (Defra 2013).

Outputs

S4P advised and trained nearly 7,000 farmers and advisers between autumn 2009 and 31 December 2013. This advice and training was free to the participants and consisted of:

- 2,469 'one to one' farm visits with advice focussing on the management of the soils, manures and nutrients. Each visit included digging at least 3 small soil pits with the farmer, to assess the physical characteristics of the soil, e.g. structure, drainage, texture, organic matter etc. and to look for signs of biological activity. The farmers who received these advisory visits managed just under one quarter of the land farmed in the South West Region.
- 3,447 soil samples, which were collected by the farmers and tested for levels of phosphate, potassium, Ph, organic matter plus the interpretation of these to the farm type.
- 251 group events and workshops covering a range of topics including how to comply with the Nitrate Vulnerable Zone (NVZ) regulations, nutrient budgeting and how to farm 'more precisely,' i.e. from assessing soil to using the latest technology for applying inputs.
- Signposting to other sources of advice and grant aid, including the former Catchment Sensitive Farming (CSF) Capital Grants Scheme, Farming & Forestry Improvement Scheme (FFIS), SWARM Small Capital Grants Scheme and Environmental Stewardship.
- 569 follow up visits or telephone calls, usually 2 years after the first visit, in order to assess which recommendations had been implemented and to provide an update on the previous advice provided.

Over 90% of the participants who completed feedback forms said that they would apply or expected to apply their new skills in practice and 99% of the farmers who responded said that they found the advice & training to be excellent or good and many positive comments were written by the beneficiaries.

The cost of delivering the project represented approximately £485 per farmer advised / trained.

Take up of the advice

A high proportion of the recommendations, made during the on-farm advisory visits, were soil related e.g. to assess soil structure for signs of compaction and to take soil samples and have them analysed for the main nutrients.

Based on the repeat visits or telephone calls, described above, S4P found that 44% of the recommendations made had been implemented. The highest proportion of recommendations implemented also related to soils including assessing soil compaction and analysing soils. The report summarises where the highest proportion of recommendations were implemented.

Findings

The report shows that of the 3,447 soil samples analysed by the project only 16% were on target for pH, 29% for Phosphate, 27% for Potassium and 35% for Magnesium (as per the Defra fertiliser management manual – RB209).

Some form of compaction was identified on 63% of the farms visited.

Benefits

The report describes how S4P achieved its objectives and exceeded its overall targets.

The main benefits delivered by the project included the savings to the farmer's production costs, usually in the form of less fertiliser used as a result of adopting nutrient budgeting. Non-farming businesses, such as machinery dealers and suppliers should have benefitted from additional sales in farm equipment. The project also supported the wider rural economy by recruiting staff, external farm consultants and hiring meeting venues. The reduction in flooding of roads and property in the South West Region and the savings to water companies, by not having to remove as much pollutant from drinking water, was also highlighted.

Other benefits such as helping farmers to tackle specific problems which they might have had on their farms; increased farm production; increased skills and confidence of the farmers; the savings in cost of public sector staff in assessing many applications for grant aid; reducing the risk to farm businesses of getting fined and the increased reputation of the agricultural industry were also referred to.

The project also led to a number of environmental benefits including cleaner water, improved soil ecology, better air quality and wildlife enhancement.

There were also social benefits for the participating farmers because they had the opportunity to share their concerns with trusted advisers and were able to meet other farmers at the group events.

Natural England benefitted by hosting the project in that it gained access to many farmers, some of whom it would have struggled to reach otherwise, contributed to its delivery of Government policy including growth, soil protection, water quality, flood reduction, climate change and achieved some really positive media coverage. The project was funded at 100% of cost. This also included funding overhead costs for each member of the in-house staff team.

A much more detailed assessment and evaluation of the economic, environmental and social benefits of the S4P Project could be carried out by an independent, third party organisation if required.

Lessons learnt

The report summarises a number of lessons which were learnt from delivering the project from the perspective of the project team and some project partners. This should prove useful to others either developing or delivering projects. The main lessons included:

- Demand appeared to exist from farmers for additional high quality, impartial advice and training which focus on the management of soils, manures and nutrients.
- Future projects and schemes aimed at advising farmers on the management of their soils would benefit from focusing on the economic benefits / efficiencies which might be gained, whilst also promoting the environmental and social benefits.
- Further analyses of the data could also be undertaken and some of the farmers advised by the project could be re-visited to see how many more recommendations have been implemented and if they have continued to implement the recommendations they initially undertook.

S4P adviser demonstrating how to look for signs of soil compaction

2 The SWARM Initiative

The S4P Project was development by Natural England in partnership with the South West Regional Development Agency (SWRDA) which later became Defra RDPE (Rural Development Programme for England). This was in response to the South West Regional Implementation Plan (SW RIP). The SW RIP identified the need to help farm businesses manage their farm resources more efficiently and to help generate economic and environmental benefits within the South West Region. S4P was launched in October 2009 and formed part of the South West Agricultural Resource Management (SWARM) Initiative.

In addition to S4P, the SWARM Initiative also included the Resource Efficiency for Farmers (R4F) project which focussed on the management of energy, water and inorganic waste; such as farm plastics. R4F was delivered by Business Link, (which became Rural Focus), through the provision of free, one to one farm advisory visits, carried out usually by a freelance farm adviser, followed by a farm visit report and action plan.

The third strand was the SWARM Hub which gathered information on resource management, stored it in a central place and then disseminated to farmers through a web site known as **swarmhub.co.uk**. The SWARM Hub was hosted by Duchy College Rural Business School, Cornwall.

For the first 20 months of the SWARM Initiative a fourth element, known as the SWARM Small Capital Grant Scheme, also existed. This scheme provided farmers the opportunity to access up to £10,000 of grant, at a maximum rate against of 40% (50% in upland areas), of a range of capital items, which must have been recommended through either S4P or R4F to be eligible. This regional grant scheme was closed and superseded in June 2011 by the national Farming and Forestry Improvement Scheme (FFIS) which did not require S4P or R4F recommendations as part of the eligibility assessment.

3 The Soils for Profit (S4P) Project

The S4P Project was managed by Natural England in partnership with the Environment Agency (EA). EA helped to set up the project, recruit staff, advised on targeting, train staff and was represented on the S4P Steering Group. S4P was represented on the South West Agriculture Pollution Prevention (SWAPP) Group, a partnership led by EA, to promote more effective, targeted and co-ordinated work on agricultural pollution prevention in the South West Region.

S4P was approved by the SWRDA on 2 June 2009 with £3.4m awarded to Natural England to train 6,200 farmers in the South West Region by 31 December 2013. It was supported, at a 100% funding rate, by the Rural Development Programme for England (RDPE), for which Defra was the Managing Authority.

The project's aim was to help farm businesses to manage their soils, manures and nutrients more efficiently, thereby improving profitability and benefitting the environment (in particular to reduce agricultural pollution, conserve soils and improve farm / landscape resilience to climate change). Due to Cornwall and the Isles of Scilly being eligible for Objective 1 funding, due to economic and social need, twenty-five per cent of project expenditure and trainee targets were aimed at that area. The remaining 75% was directed at farmers in the 'rest of the region', i.e. Devon, Somerset, Dorset, Wiltshire, Gloucestershire and the old county area, often referred to as Avon. (Avon was used because Defra maintained separate county / parish / holding (CPH) numbers for the area).

The project objectives were to:

- Provide training and best practice advice on resource management for land based businesses.
- Improve the management of soils involved in agricultural production.
- Improve the management of organic wastes, manures and inorganic fertilisers.

The breakdown of project costs, agreed at the outset was:

Cornwall & Isles of Scilly	
In house delivery	£418,560
External / Contractor Delivery	£405,640
Promotion & Marketing	£25,800
Total	**£850,000**
Rest of Region	
In house delivery	£1,669,260
External / Contractor Delivery	£830,400
Promotion & Marketing	£50,340
Total	**£2,550,000**

The project consisted of 3 elements that were all free at the point of delivery:

- On Farm Review of Soils, Manures and Nutrients.
- Follow-up advice including an assessment of uptake of previous recommendations.
- Group training sessions.

The rest of Section 3 describes each of these 3 elements in more detail. The map at Appendix I shows an indication of where delivery was located, by postcode, across the former South West Region. It also shows NVZs and CSF target areas. A selection of photographs, which help to demonstrate delivery, can be seen at Appendix II.

On farm reviews of soils, manures and nutrients

One to one advisory visits were delivered by either in-house advisers or external consultants appointed through tender. They were available between the autumn of 2009 and the summer of 2013, once only, to every farm with over 5 ha of agricultural land who requested one. (The minimum size threshold was waived for farmers located on the Isles of Scilly where most farms are smaller than 5 ha).

Each visit included demonstrating to the farmer how to assess the texture and structure of the soil in at least 3 different fields, identifying issues such as soil compaction and the best and most cost effective method of preventing and rectifying this.

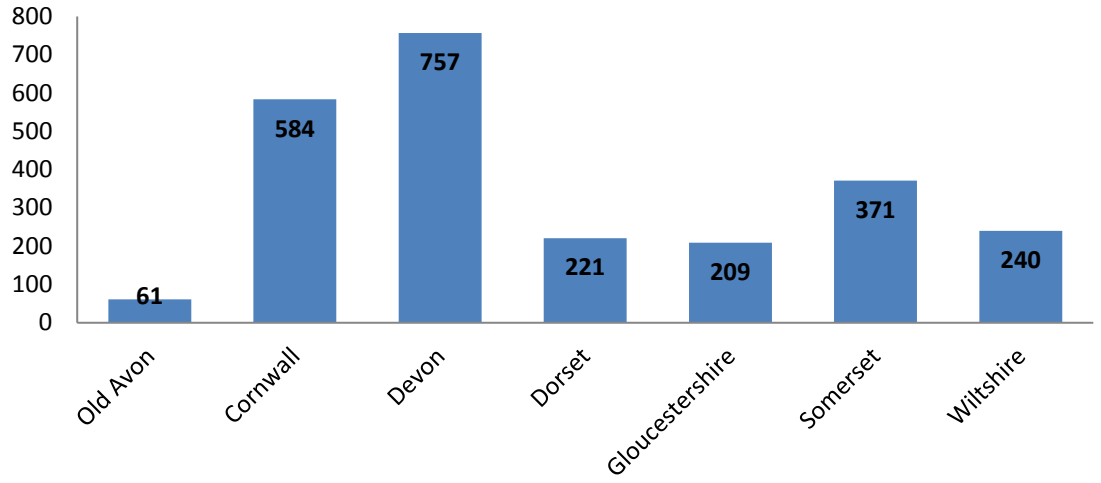
The advice also covered the production, storage and handling of livestock manures (if relevant). The nutrient value of manures was emphasised and nutrient budgeting was demonstrated when required. The benefits and viability of using the latest technology were also discussed, e.g. variable rate fertiliser applicators, yield mapping and GPS guidance.

Each farmer received a written report / action plan, known as an *On Farm Review of Soils, Manures and Nutrients*, after the visit. This included recommendations in priority order, to deliver the greatest economic and environmental return. Signposting to other sources of relevant support was also routinely included e.g. other RDPE projects such as R4F, Environmental Stewardship etc. A copy of an anonymised report can be seen at Appendix III.

Overall the project delivered 2,469 On Farm Reviews of Soils, Manures and Nutrients. Figure 1 below shows the breakdown of the S4P On Farm Reviews of Soils, Manures and Nutrients which had been delivered between the start of the project and 30 September 2013. This is broken down on a county basis.

This graph shows that most S4P On Farm Reviews of Soils, Manures and Nutrients were delivered in Devon, which is the largest county in the South West and has the most farm businesses. Next was Cornwall and the Isles of Scilly due to the additional promotion S4P undertook to meet the specific delivery targets for that county.

Figure 1: Number of S4P On Farm Reviews of Soils, Manures & Nutrients delivered per county



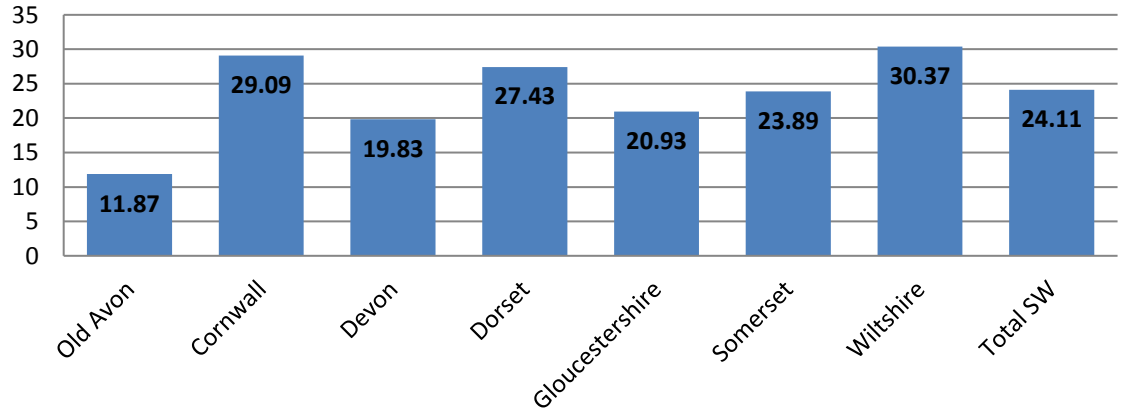
Project coverage

The approximate land area managed by the 2,469 farmers visited and advised totalled approximately 424,000 hectares. This represents an average farm size of 171 ha.

Figure 2 below shows the percentage of the total farmland managed by the farmers who received an S4P On Farm Reviews of Soils, Manures and Nutrients, on a county and former South West Regional basis, as compared to the total farmland in the same areas as recorded in the Defra Census of 2011.

This shows that S4P advised farmers who manage just under a quarter of the farmed area in the South West Region, over 30% in Wilshire and nearly 30% in Cornwall & the Isles of Scilly. The 8 maps at Appendix IV show the approximate location of these land areas across the former South West Region and also each county.

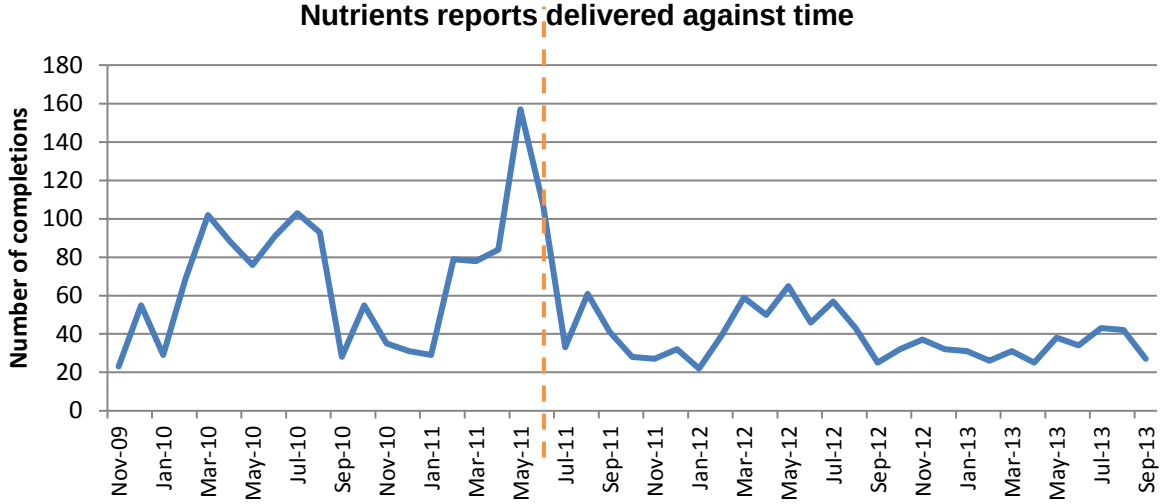
Figure 2: Percentage of land area managed by farmers who received a S4P On Farm Review of Soils, Manures & Nutrients as compared to total farmland by county and region



Delivery profile

Figure 3 below shows the number of S4P On Farm Reviews of Soils, Manures and Nutrients delivered against time between November 2009 and September 2013. The dashed orange line represents the end of the SWARM Small Capital Grant Scheme (SCGS).

Figure 3: Number of S4P On Farm Review of Soils, Manures and Nutrients reports delivered against time



This graph shows that the peak time for sending out completed reports were usually March to June. This is because more visits were usually carried out during the winter months when farmers tend to be less busy with field operations and are generally more willing to participate in an advisory meeting. It also reflects the time lag between the farm visit and the adviser writing and sending the report to the farmer.

The graph also shows that the number of reports delivered increased dramatically just before the closure of the SWARM Small Capital Grant Scheme (SCGS). This was because many farmers, most of whom were already in the S4P 'pipeline,' were encouraged by S4P to benefit from the advice and grant support, before the grant scheme closed for new applications. (At that time it was also a requirement of the SWARM SCGS that an advisory visit and report should be sent to SWRDA / Defra RDPE South West to support a grant application).

The number of reports produced fell significantly in the summer / autumn following the closure of SCGS. This was because the incentive of the SCGS had disappeared and many of the farmers in the S4P 'pipeline' had been dealt with.

Following the closure of the SWARM SCGS, Natural England gained the approval of the SW RDA for the S4P Project to introduce the free analysis of 5 soil samples for each farmer who had not already benefitted from an S4P farm advisory visit. This was aimed at stimulating demand for the project, having lost the link to the grant scheme, but also helped inform the on-farm advice. This led to an increase in demand over the winter of 2011/12 and then a steady flow of referrals and completions for the rest of the project period. However the numbers never returned to pre SWARM SCGS levels.

The graph at Figure 3 also shows a period of build up at the start of the project and wind down towards its end.

Targeting

One of the main reasons why SW RDA tasked Natural England and the EA to develop the project was to enable farmers based outside of CSF Target Areas to benefit from advice and training on soils, manures and nutrients. Therefore one of the main principles behind the S4P Project was that it should be open to farmers across the whole of the former South West Region. However, in order to ensure that funds remained available across the whole project period a minimum farm size of 5ha was introduced for participants.

It was agreed between S4P and the SW RDA that project promotion should be the main tool used for targeting of activity. The following areas were selected as priorities:

- Cornwall and the Isles of Scilly
- Nitrate Vulnerable Zones
- Water Framework Directive (WFD) Failing Water Bodies.

This resulted in approximately 46% of S4P advisory visits (1,116) taking place in NVZ areas and around 24% (584) in Cornwall and the Isles of Scilly. An assessment of S4P take up in WFD areas was not carried out.

Delivery in Catchment Sensitive Farming (CSF) areas

Although the policy objectives of S4P and CSF were slightly different, many of the messages contained in the advisory and training activity, surrounding soils, manures and nutrients were similar. Indeed one of the main reasons why Natural England and EA were chosen to develop the S4P Project was because of their previous experience and success in jointly delivering CSF.

S4P was very integrated with CSF at various levels - a situation which was assisted by the CSF national lead being chair of the S4P steering group.

In CSF Target Areas S4P mail promotion was avoided, where possible, in order to avoid the impression that S4P was competing with CSF and to reduce possible farmer confusion.

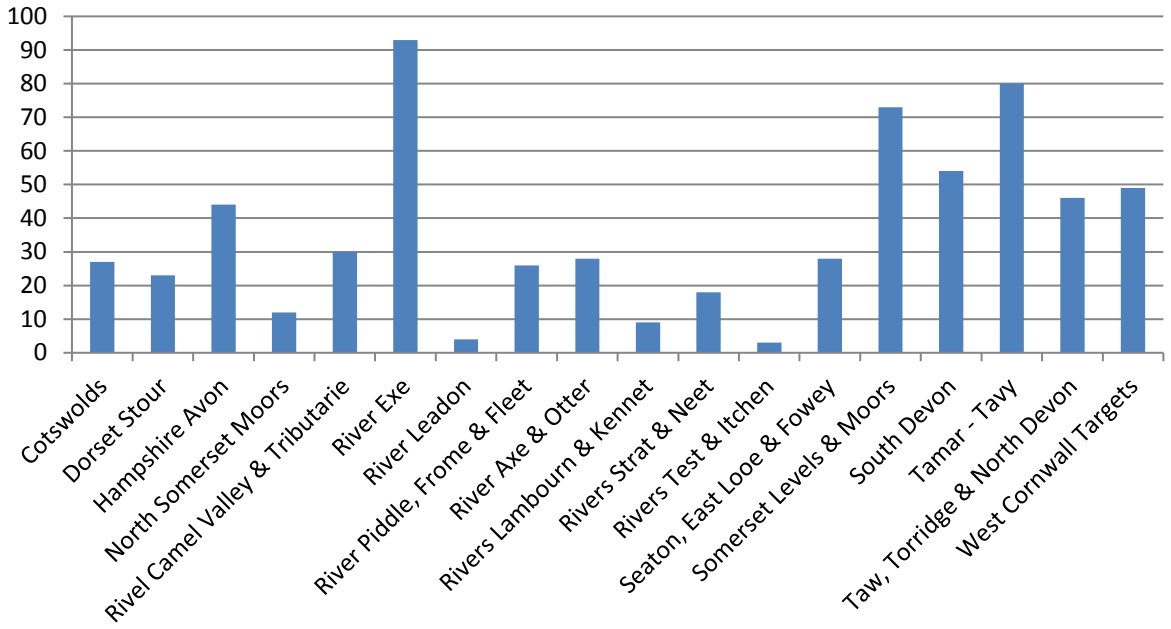
S4P was available to farmers in CSF target areas on a ‘broad and shallow’ / ‘review’ type basis with a more detailed CSF input offered when particular needs were identified. There were many examples where CSF and S4P advisers delivered in partnership and where farmers had already received CSF support S4P would either refer them back to CSF for more in-depth advice, if required, or S4P would focus on any issues which had not been covered.

As at 30 September 2013 approximately 26% of the S4P advisory visits had been carried out in CSF Target Areas. This was helped by:

- CSF Officers (CSFO) promoting S4P.
- A S4P advisory report adding weight, through additional scoring, to a CSF Capital Grant Scheme (CGS) application.
- A number of S4P group events being held in CSF Target Areas in consultation with CSFOs.

Figure 4 shows the uptake of S4P On Farm Reviews of Soils, Manures & Nutrients by former CSF Target Area between October 2009 and 30 September 2013.

Figure 4: Number of S4P On Farm Reviews of Soils, Manures & Nutrients delivered by former CSF Target Areas



The reasons for the differences in S4P uptake between CSF target areas include:

- The size of the target areas.
- The number of farmers in each CSF target area.
- The level to which CSF promoted S4P.
- The degree to which the catchment was in the former South West Region (e.g. River Leadon).

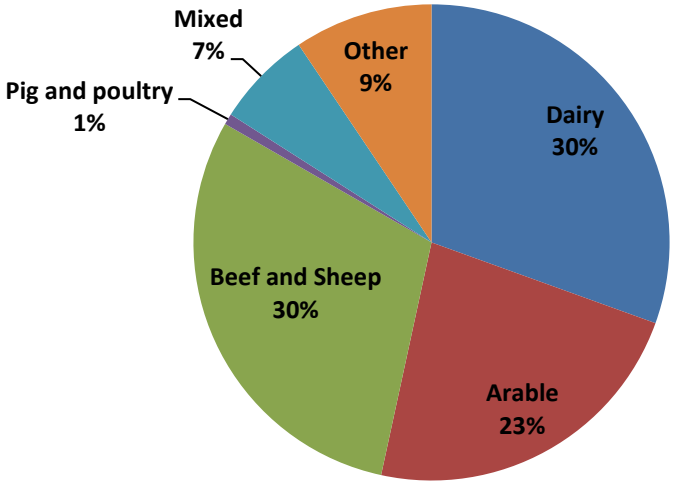
It is understood that demand for CSF advice and training for reducing water pollution and supported grant applications in the South West still exceeds similar areas outside the South West. This is considered to be partly due to the additional promotion of the topic which S4P generated and the co-operation which took place between CSF and S4P staff.

S4P On Farm Reviews of Soils, Manures & Nutrients by farm type and participant gender

Figure 5 below shows the main enterprises present on the farms which received a S4P On Farm Review of Soils, Manures & Nutrients between October 2009 and 30 September 2013 based on the information provided by farmers at the time of registration. (The definition “Other” might include goats, alpacas, horticulture and horses and the definition of “Mixed” is when a combination of the other main activities are present).

This chart shows a good spread of farm enterprises which is representative of the farming systems found across the former South West Region.

Figure 5: Main enterprise on farms which received a S4P On Farm Review of Soils, Manures & Nutrients



Further analysis shows that across the former South West Region approximately three quarters of the farmers who received an S4P On Farm Review of Soils, Manures and Nutrients had livestock, (this proportion was slightly higher in Cornwall & the Isles of Scilly and lower in the Rest of the South West Region).

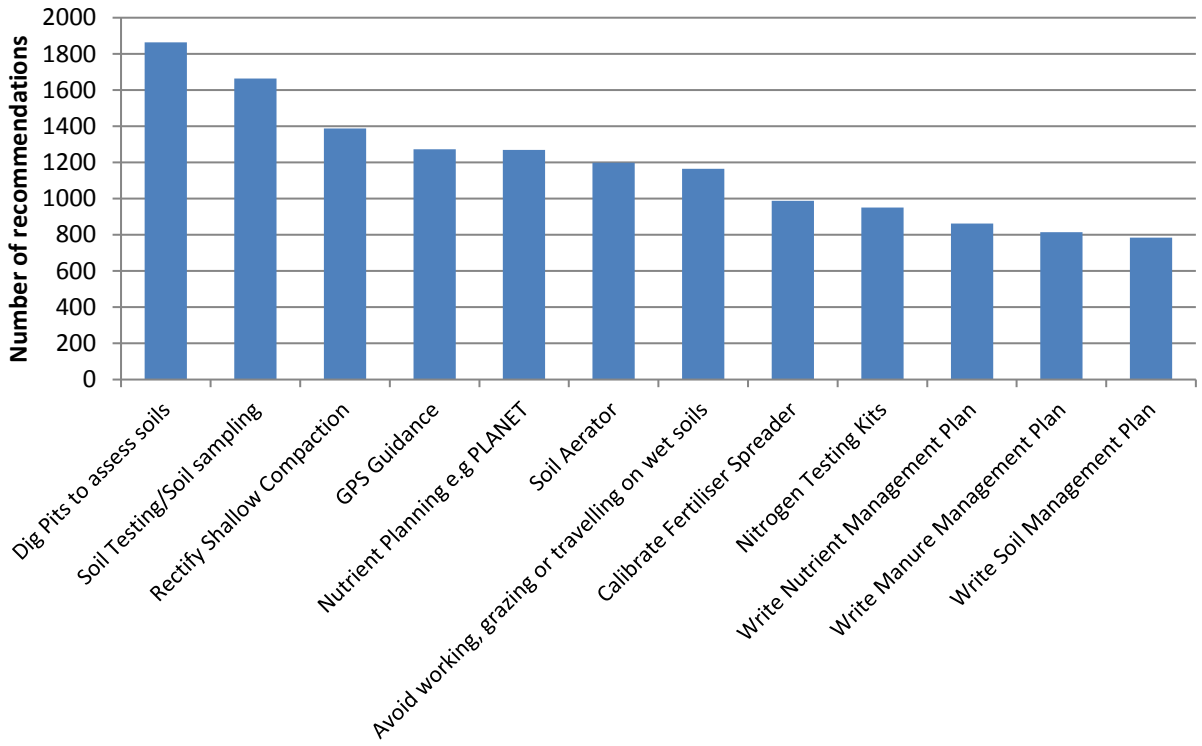
86% of all the S4P beneficiaries across the South West were male and 14% were female. The percentage of male beneficiaries was slightly higher in Cornwall & the Isles of Scilly and lower in the rest of the SW Region.

The data also show that the percentage of female beneficiaries was higher for the group training events (see later) as compared to the S4P On Farm Review of Soils, Manures and Nutrients.

Recommendations

The 12 most common recommendations made by 30 September 2013 as taken from the S4P On Farm Review of Soils, Manures and Nutrient reports, are shown in Figure 6 below.

Figure 6: The 12 most common recommendations made

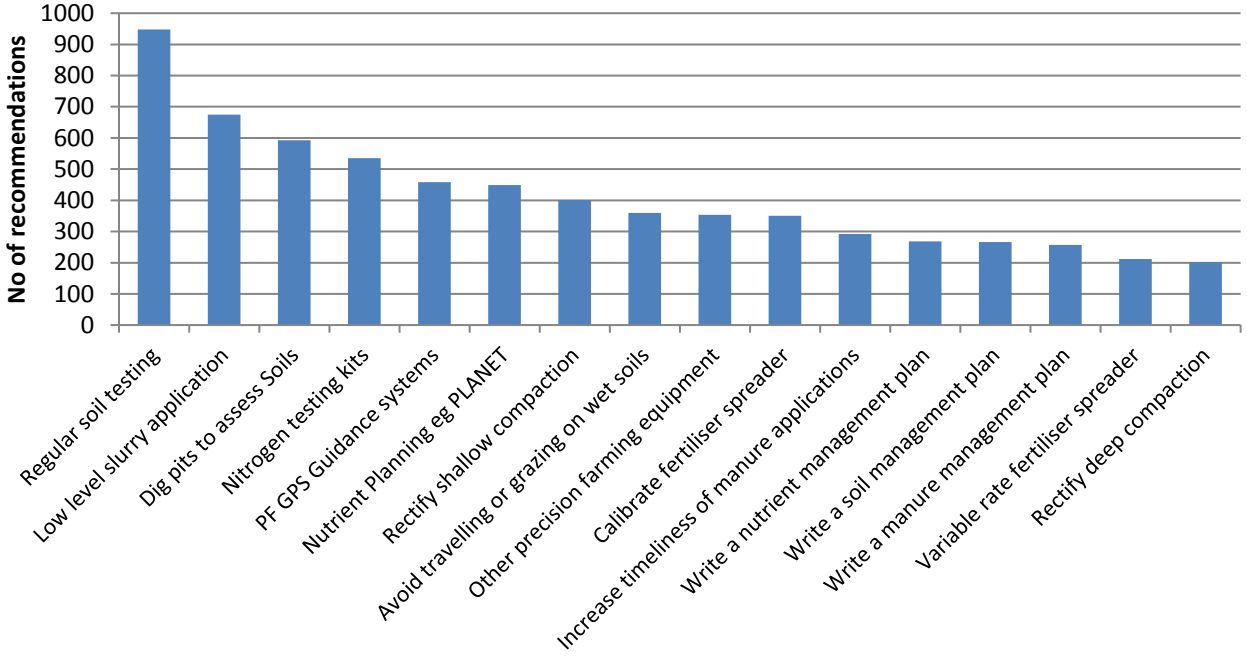


The graph shows that the most common recommendation was to dig further soil pits to assess soil structure for signs of compaction. Section 7 of this report confirms that compaction was identified on approximately 63% of the farm holdings visited.

Breakdown of the most common recommendations by enterprise

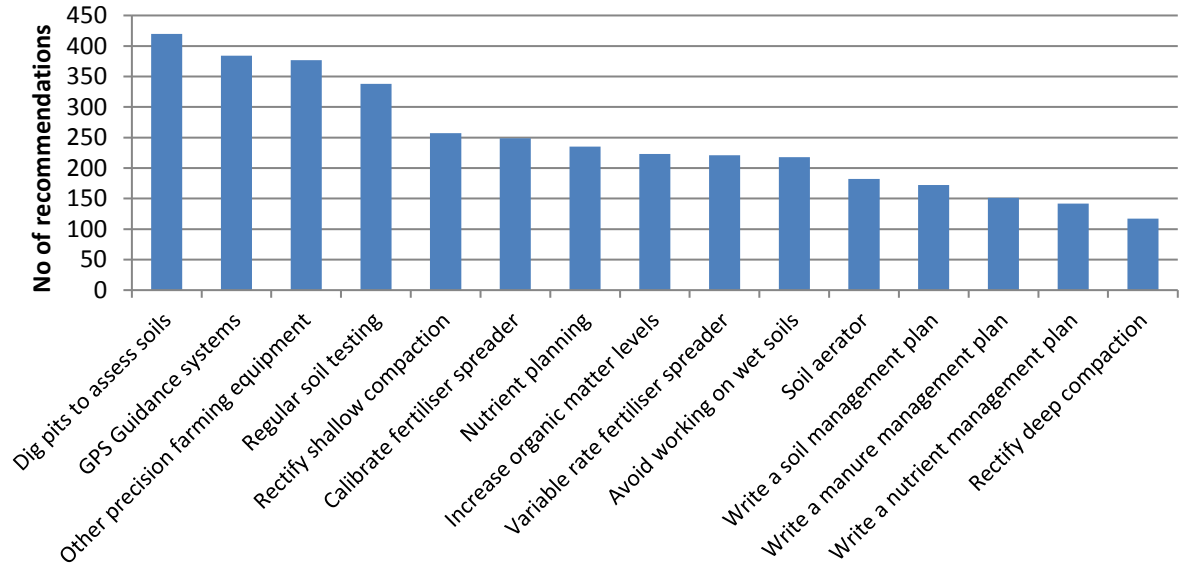
Figures 7 – 10 show the most common recommendations made by S4P for different types of farm.

Figure 7: The most common S4P recommendations made to dairy farmers



Soil testing & digging further soil pits to assess soil for signs of compaction were two of the most common recommendations provided to dairy farmers. More targeted application of slurry and using nitrogen testing kits, to assess the nitrogen content of slurry and manures, were also popular recommendations.

Figure 8: The most common recommendations made to arable farmers



The most common recommendation for arable farmers was the digging of further shallow pits to look for signs of soil compaction. The use of precision farming equipment, for example GPS guidance systems and variable rate fertiliser applicators, were also popular recommendations.

Figure 9: The most common recommendations made to mixed farmers

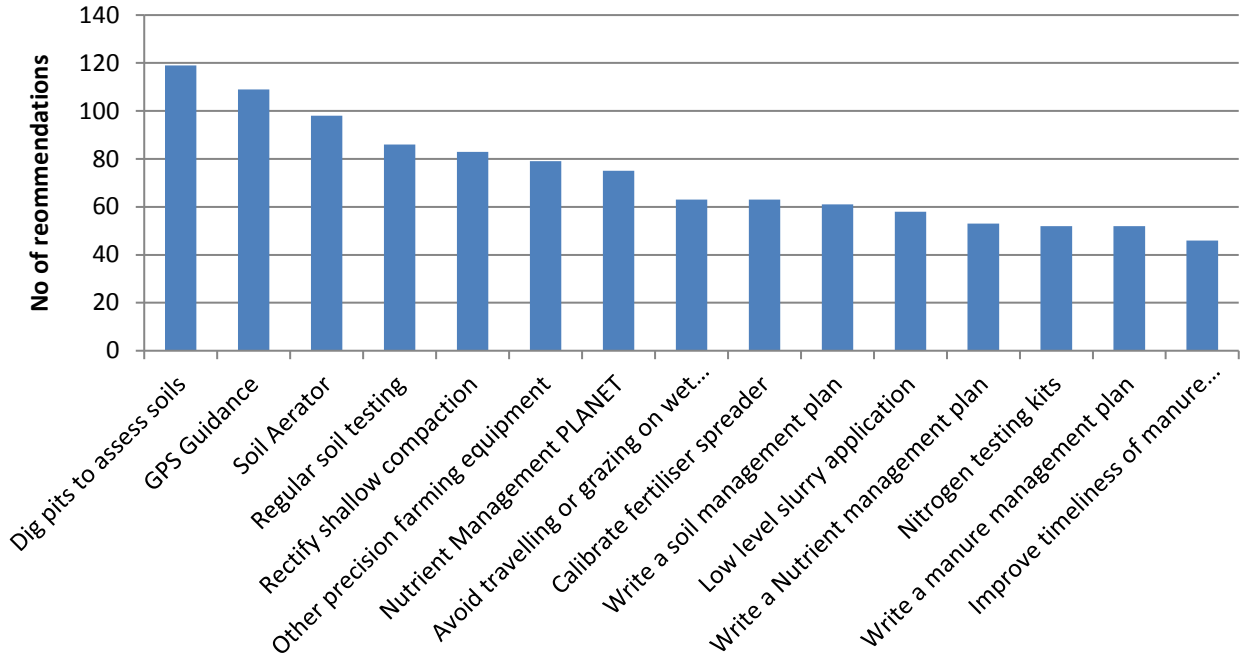
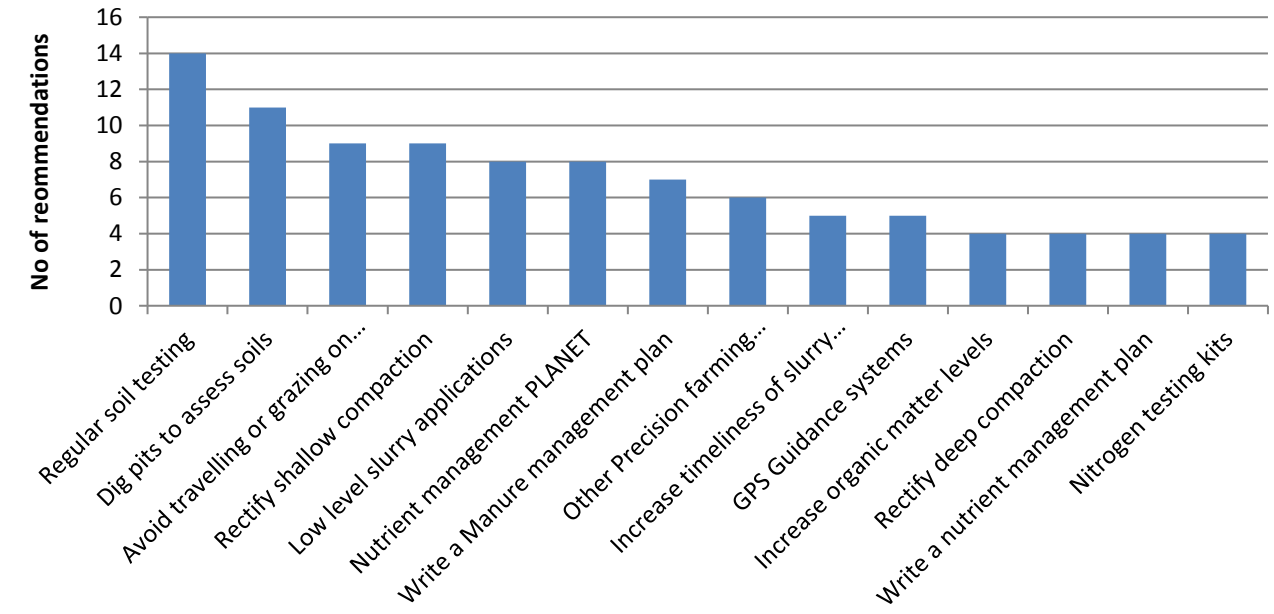


Figure 9 above shows that the most common recommendations for mixed farms were related to soils and precision farming.

Figure 10: The most common recommendations made to pig and poultry farmers



As pig and poultry farms usually have large volumes of manure to handle, it is not surprising to see in Figure 10 that regular soil testing is the most common recommendation because it can help to avoid the possible over application of certain nutrients from pig and poultry manures.

Testing soil & assessing soil compaction were the most common recommendations for beef and sheep farmers.

Follow up advice

Free follow-up advice was offered usually at least 2 years after the first S4P advisory visit. This was taken up by 514 farmers between 14 February 2012 and 30 September 2013 and represented approximately 20% of the farmers who received an On Farm Review of Soils, Manures and Nutrients. This advice was provided by the Natural England S4P in-house advisers usually during a repeat visit but sometimes over the telephone. The advisers were empowered to select the farmers. Some worked down an alphabetical list whilst others targeted farmers and areas where they considered that follow up advice would be most beneficial.

This follow up advice included a review of the recommendations which had previously been made and an update to the farmer on recent developments. A letter confirming what had been discussed was sent afterwards. A copy of an anonymised example letter can be seen at Appendix V.

The advisers found that 44% of all the recommendations made to these farmers during their first visit had been implemented.

The green line, in Figure 11 below, shows the number of S4P follow-up advisory engagements when compared against the right hand vertical axis delivered on a county basis. No follow up engagements were carried out in the former county of Avon due to the lack of in-house S4P staff dedicated to that area at that time.

The blue columns in Figure 11, when compared to the left hand vertical axis, show the total number of recommendations that were made to these farmers, following the first advisory visit, by county. The darker shading shows the number of recommendations that had actually been implemented by these same farmers. The highest proportion of recommendations implemented was 76% in Wiltshire and the lowest was approximately 40% in Somerset.

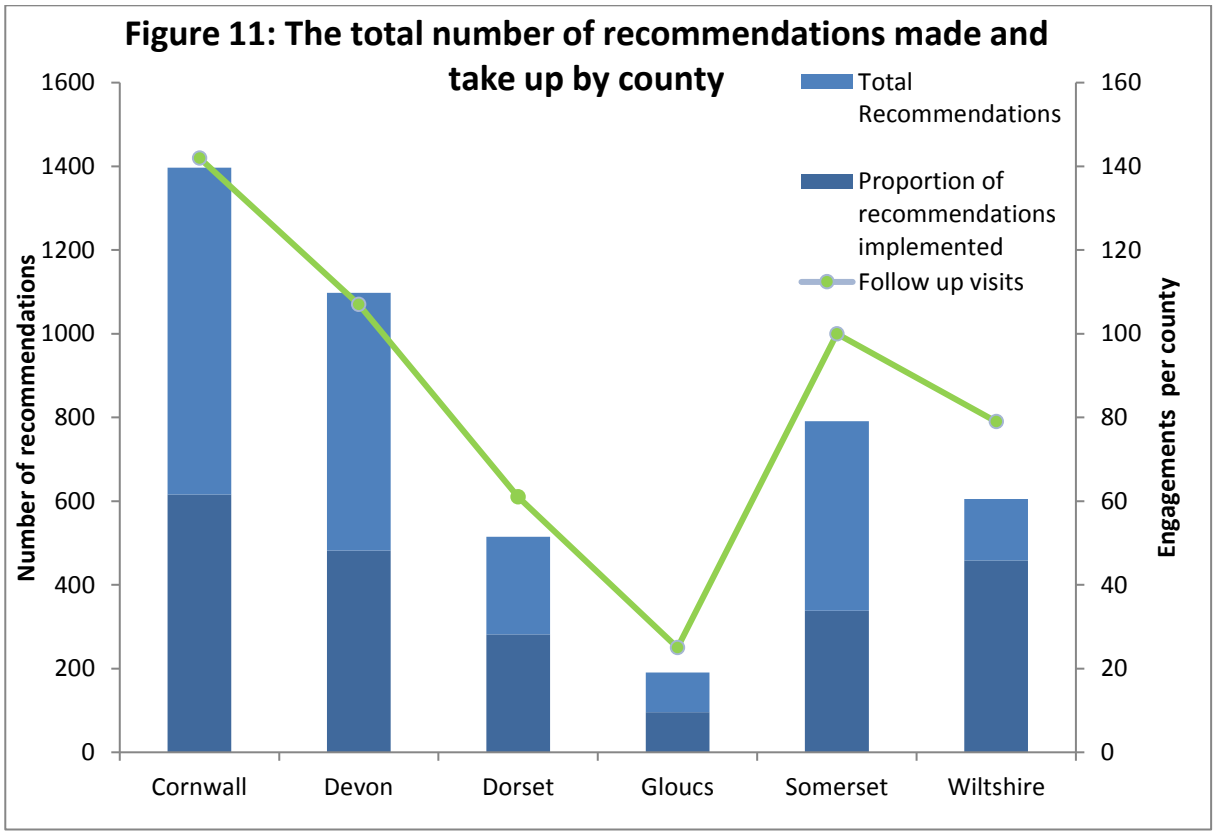
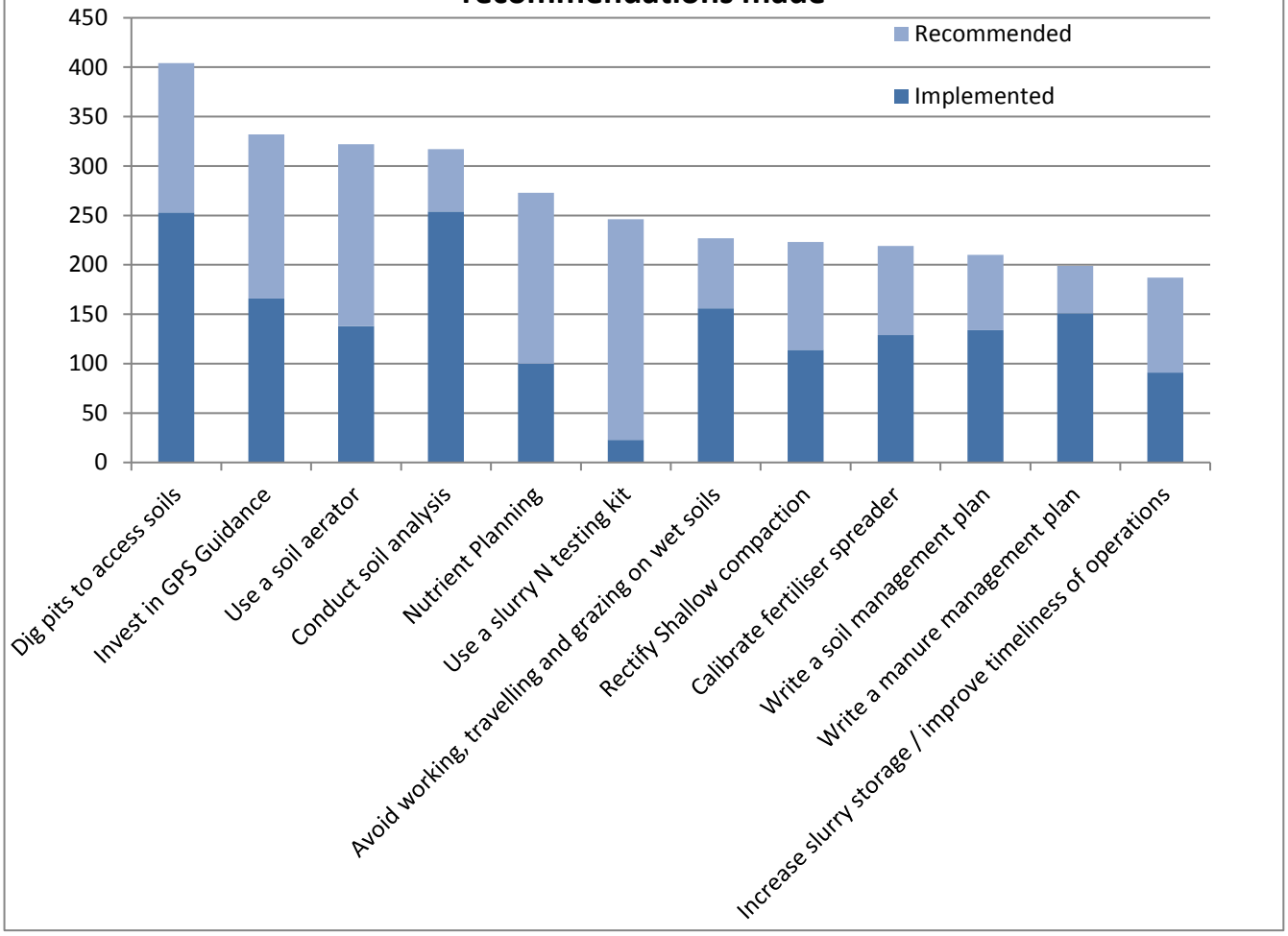


Figure 12 below shows the number and type of recommendations implemented by those farmers who received follow up advice, compared to the most common recommendation which they received. The data suggests that the recommendations related to soils e.g. analyse soils, dig further shallow pits to assess soils for compaction etc. were implemented the most. This was because soils were the main focus of the project and the recommendations could be implemented relatively quickly, at relatively low cost and can deliver strong benefits.

Figure 12: The number and type of recommendations implemented compared to the number and type of recommendations made



Most common recommendations made and take up by county

The top recommendations, which were made during the S4P On Farm Reviews of Soils, Manures and Nutrients, are shown on 3 graphs in Appendix VI. They are divided into the most common 12, middle 12 & lowest 12 recommendations. These graphs also show how many times each recommendation had been implemented by county.

The graphs reinforce the point that the recommendations relating to soil management were prioritised by farmers probably for the same reasons as suggested above.

S4P group training

Between September 2010 and 31 December 2013 S4P held 251 training events, with nearly 3,100 farmers benefiting, giving an average of 12 farmers per event. These events were delivered mainly by external consultants supported by in-house advisers. The consultants were appointed by tender exercises through the former Farm Advice and Training (FATI) framework process. The events included:-

- Workshops for groups of 10-15 farmers focussing on the NVZ Regulations. Draft NVZ calculations were carried out for illustrative purposes, and the opportunity for further specific advice by telephone, for a limited period was also offered.
- Nutrient budgeting workshops for smaller groups of farmers some of which included an introduction to the PLANET nutrient budgeting software and others an update course on the same.
- Farming More Precisely events included training on using a spade to check soil for signs of compaction to nutrient budgeting, investing in the latest technology to the benefits of complying with Cross Compliance and NVZ regulations. Practical participative sessions were included such as looking at a selection of soil pits and pieces of equipment. In the last series, an update was provided by a host farmer who had received advice through the S4P Project and had implemented some of the recommendations. The events were labelled “farming more precisely” in order to attract a wide group of farmers. These events were about incremental improvements in efficiency rather than a full change in behaviour to the most technically advanced farming such as “precision farming”.
- Other group sessions were also delivered such as training on how to complete Soil Protection Reviews plus general S4P grassland management events.

Figure 13 below is a breakdown of group training events delivered between September 2010 and 30 September 2013 by type, county and number of participants.

Figure 13: Number of group training events and number of participants by type and county

	Old Avon	Cornwall	Devon	Dorset	Gloucs.	Somerset	Wiltshire	**TOTAL**
NVZ events								
Events	4	12	21	16	15	10	17	**95**
Participants	52	139	299	165	173	89	179	**1096**
Nutrient Planning								
Events	4	9	11	6	13	7	13	**63**
Participants	26	37	66	32	69	37	87	**354**
Farming More Precisely and Other S4P Training events								
Events	2	20	19	13	11	15	8	**88**
Participants	17	284	385	240	188	305	130	**1549**
Total								
Events	**10**	**41**	**51**	**35**	**39**	**32**	**38**	**246**
Participants	**95**	**460**	**750**	**437**	**430**	**431**	**396**	**2,999**

The S4P database indicated that:

- 73% of the beneficiaries at S4P events were aged 40 or over,
- 19% were aged between 25 and 40,
- 8% were under 25.

The percentage of farmers under 40 (Young Farmers) who attended events held in Cornwall & the Isles of Scilly was higher than for the Rest of the SW Region.

4 Review of the S4P Project against its objectives and targets

The objectives for the S4P Project, as contained in its offer letter, are listed at the beginning of Section 3. This section demonstrates that S4P delivered all of these objectives i.e.

- It provided training and best practice advice on resource management for land based businesses
- It improved the management of soils involved in agricultural production
- It improved the management of organic wastes, manures and inorganic fertilisers.

Below is a summary of the 4 main output targets which were set in each area (Cornwall & Isles of Scilly and Rest of SW Region) plus a commentary on performance and a statement as to whether the target was achieved or not.

Cornwall & the Isles of Scilly - Number of participants in training – 1550. Target Date: 31/12/13

NB The term participants in training was confirmed by Defra as meaning farmers with their own holding number(s) who received training & advice on a one to one or group basis from an S4P adviser.

The target number of participants for Cornwall and the Isles of Scilly always seemed disproportionately high when compared to the targets for the other 6 counties in the Rest of Region area. Therefore part way through the project, when it was clear that the output for the Cornwall & Isles of Scilly area was behind target, discussions took place with Defra about reducing the Cornwall & the Isles of Scilly participants target by 200 and then increase the Rest of the Region target by the same figure. Rather than doing this, Defra wrote *"Defra acknowledges that likely number of participants in training for Cornwall & Isles of Scilly will fall short of the target". Defra went on to say" this reduction is expected and beyond the control of NE and I confirm that no adverse action or penalties will be applied as a result …."*

The actual number of participants in training by 31 December 2013 was 1,509. Therefore, despite a huge effort being made by the S4P Project team, in terms of additional project promotion, the actual target was only missed by 41 farmer participants.

Cornwall & the Isles of Scilly - Number of training days received – 705. Target Date: 31/12/13

The number of training days received by participants in training by 31 December 2013 was exactly 705 days i.e. 100% of target. Therefore this target was achieved.

Cornwall & the Isles of Scilly - Number of participants that successfully ended a training activity related to agriculture and / or forestry (85% successfully completed) – 1317. Target Date: 31/12/13

The number of participants that successfully ended a training activity related to agriculture and / or forestry by 31 December 2013 was 1,509. Therefore this target was achieved and exceeded.

Cornwall & the Isles of Scilly - 80% of participants have applied or expect to apply the acquired skills in practice – 1240 Target Date: 31/12/13

By 31 December 2013, of the 805 feedback forms which had been returned and loaded onto the S4P database (from farmers who had received a S4P On Farm Review of Soils, Manures & Nutrients), 99% said that they would "expect to apply the skills acquired in practice."

Based upon the 2,221 feedback forms from farmers who had received training, during a S4P group training event, 93% of the farmers said that they would "expect to apply the skills acquired in practice."

Therefore if an average of the two is used, i.e. 96%, and then multiplied by the number of participants specifically in Cornwall & Isles of Scilly i.e. 1,509, this produces a figure of 1,448 participants who have applied or expect to apply the acquired skills in practice. Therefore this target was achieved and exceeded.

Rest of South West Region - Number of participants in training – 4,650. Target Date: 31/12/13

The actual number of participants in training by 31 December 2013 in the Rest of the Region area was 5,425. Therefore this target was achieved and exceeded.

Rest of South West Region - Number of training days received – 2,094 Target Date: 31/12/13

The number of training days received by participants in training by 31 December 2013 was 2,831 days. Therefore this target was achieved and exceeded.

Rest of South West Region - Number of participants that successfully ended a training activity related to agriculture and / or forestry (85% successfully completed) – 3,952 Target Date: 31/12/13

The number of participants that successfully ended a training activity related to agriculture and / or forestry was 5,425. Therefore this target was achieved and exceeded.

Rest of South West Region - 80% of participants have applied or expect to apply the acquired skills in practice – 3,720 Target Date: 31/12/13

If the same 96% apportionment rate is used, as described for the corresponding target for Cornwall & Isles of Scilly above, and then multiplied by the number of participants in this area, i.e. 5,425, this produces 5,208 participants who have applied or expect to apply the acquired skills in practice. Therefore this target was achieved and exceeded.

Financial targets

Towards the end of the project Defra agreed to revise the funding schedule to reflect the stronger delivery in the Rest of the Region area compared to Cornwall & Isles of Scilly. The breakdown of project costs in the final revised funding profile, as compared to the initial offer letter, is shown in Figure 14.

Figure 14: Project Costs	**Initial**	**Revised**	**Variance**
Cornwall & Isles of Scilly			
In house delivery	£418,560	£475,498.90	+£56,938.90
External / Contractor Delivery	£405,640	£307,597.08	-£98,042.92
Promotion & Marketing	£25,800	£32,987.35	+£7,187.35
Total	**£850,000**	**£816,083.33**	**-£33,916.67**
Rest of Region			
In house delivery	£1,669,260	£1,390,185.15	-£279,074.90
External / Contractor Delivery	£830,000	£1,131,345.23	+£300,945.20
Promotion & Marketing	£50,340	£62,386.29	+£12,046.29
Total	**£2,550,000**	**£2,583,016.67**	**+£33,916.67**

In summary the S4P Project:

- Achieved all 3 of its objectives.
- Met 3 of the 4 project output targets allocated to the Cornwall & Isles of Scilly area and missed the 4th by a small amount.

- Exceeded all 4 of the output targets allocated to the rest of the Region area.
- Exceeded all 4 project output targets if the two sets of targets were combined across the whole South West Region.
- Met its revised spend targets which represented an overall cost per farmer advised / trained of £485.

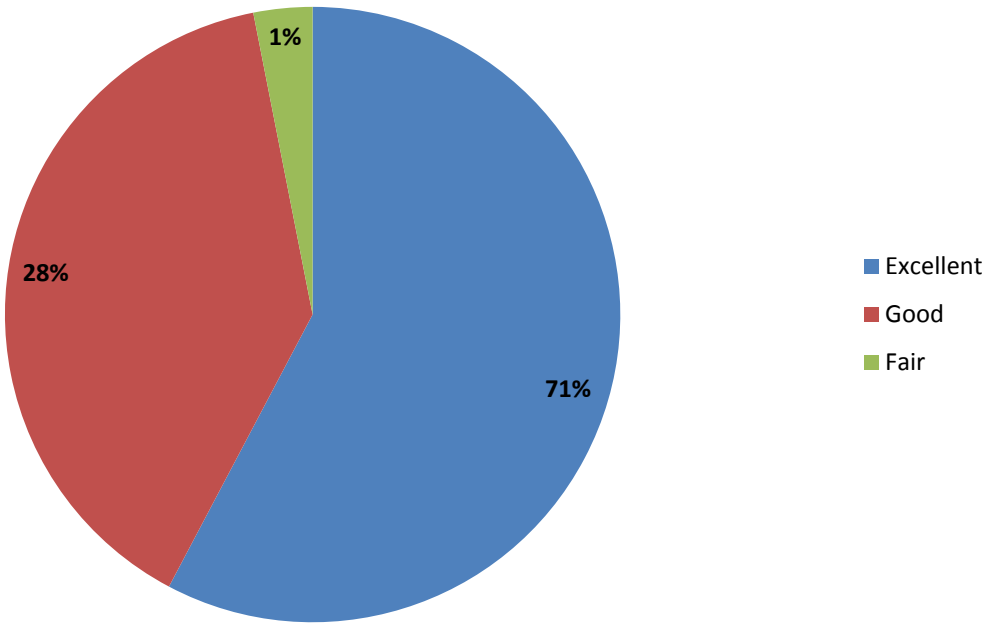
5 Feedback

S4P On Farm Reviews of Soils, Manures and Nutrients

Figure 15 below illustrates the feedback received from the 805 farmers responded following the 2,469 S4P On Farm Reviews of Soils, Manures and Nutrients between October 2009 and 31 December 2013 across the whole South West Region.

Ninety-nine per cent of these farmers, who were asked how they rated the advice which they had received, responded by saying that they found it to be good or excellent. Over 70% of those who responded said it was Excellent.

Figure 15: Summary of feedback received following receipt of On Farm Review of Soils, Manures and Nutrients



The following questions were also included in the feedback exercise and the response was:-

Question	Percentage of Yes answers
Do you have improved understanding?	95%
Do you expect to use the skills learnt in the future?	99%
Would you recommend to other farmers?	98%
Would you engage with S4P in the future?	96%

In addition to the printed questions contained in the feedback forms, the farmers who received S4P On Farm Resource Reviews of Soils, Manures and Nutrients also had the opportunity to provide any specific comments which they wished. A selection of the many positive comments received can be seen at Appendix VII. These included comments like:

- "I was very pleased with the visit, and gained and refreshed my knowledge of soil management, and as far as we can afford, will put the recommendations into practice."
- *"The adviser I had here was first class and had an answer for every question I posed. Absolutely superb service. Thank you."*
- *"I think more farmers should take time to think about the quality and fertility of their soils, especially larger livestock farms carrying large headage on wetter land, causing compaction."*
- *"I found the S4P adviser to be very knowledgeable and he offered very good practical advice on all aspects of soil management. I plan to do a lot more digging in the future!"*
- *"Very happy with the outcome of the visit – the adviser was very knowledgeable and explained issues in a clear and concise way."*
- *"A very much one-to-one approach which is very worthwhile to the farmer …."*
- *"Superb service – brought details to forefront which had been slightly neglected, i.e. soil sampling grass grounds – hopefully will encourage better management."*
- *"Thank you for your effort to improve farmers' understanding of NVZs and nutrient management. Also thank you for the free soil samples."*
- *"Many thanks for the comprehensive and useful report."*
- *"Excellent down to earth approach from people who understand farming and farmers."*
- *"Very interesting and very helpful. Thank you."*

S4P group training

2,221 of the 3,100 beneficiaries from the S4P group training events, held across the whole South West Region, completed evaluation forms. A summary of the feedback is as follows:

- Trainers knowledge - 62% Excellent, 37% Good, 1% Fair, 0% Poor
- Expect to apply the skills - 93 % Yes
- Recommend to other farmers - 92 % Yes.

6 An analysis of the soil sample result data

After the closure of the SWARM Small Capital Grant Scheme in 2011 the S4P Project agreed with the SWRDA / Defra RDPE that it should encourage farmers, who had not previously benefitted from a S4P Review of Soils, Manures and Nutrients, to collect soil samples from up to five fields, of their choice, and to send these to the chosen laboratory to be analysed and a report provided free of charge.

The results from the soil analysis were used by the S4P farm advisers to support advice, specific to the farm as part of the S4P On Farm Resource Review of Soils, Manures and Nutrients, and in particular, to help demonstrate nutrient budgeting.

This arrangement did not seek to replace the market for undertaking these analyses, but used the opportunity to prove its value and benefits to farmers which it is considered subsequently expanded the service for the private sector.

The SWARM Hub, in association with S4P staff, collated and analysed the data from 3,447 separate soil samples. Details of the findings can be seen in the paper at Appendix VIII. The main conclusions reached were:

- Only 16% of the samples were within the target range for pH as recommended by the Defra Fertiliser Manual 2010 RB209. 47% were below and 37% were above.
- 29% of the samples were within the target range for Phosphorous as recommended by the Defra Fertiliser Manual 2010 RB209. 41% were below and 30% were above.
- 27% of the samples were within the target range for Potassium as recommended by the Defra Fertiliser Manual 2010 RB209. 39% were below and 34% were above.
- 35% of the samples were within the target range for Magnesium as recommended by the Defra Fertiliser Manual 2010 RB209. 3% were below and 62% were above.
- 11% of the arable soils and 1.5% of grassland soils were less than the relevant Soil Organic Matter (SOM) benchmark.

7 Soil compaction

Of the 2,443 farms which received a S4P On Farm Review of Soils, Manures & Nutrients between October 2009 and September 2013, soil compaction was found in at least one field, on 1,534 of the total farms visited, i.e. 63%. The results are based on a visual assessment revealed by digging a shallow pit, usually in up to three different fields on each farm, and by making reference to the Environment Agency's Think Soils Publication entitled – Soil assessment to avoid erosion and runoff.

The incidence of soil compaction was spread across the whole South West Region although it was found to be higher in Devon (73%) and Gloucestershire (64%) than in Wiltshire (51%) or in the former county of Avon (49%). The percentage of farms with soil compaction in Cornwall (60%), Somerset (59%) and Dorset (57%) was slightly less than the South West average.

The 7 maps at Appendix IX show the land areas managed by farmers who received an S4P On Farm Review of Soils, Manures & Nutrients and, overlaid in red the land holdings on which signs of soil compaction were found in at least one field. The maps cover the former South West Region and each county.

Where signs of soil compaction were identified the farmer was encouraged to carry out further inspections in that field and extend it to other fields. The adviser provided practical advice to help tackle soil compaction with a view to helping address possible problems such as increased water run-off and possible soil erosion, reduced crop rooting etc. The adviser also pointed the farmers in the direction of other useful sources of guidance and support, including grant assistance. Many farmers were able to investigate soil compaction themselves, elsewhere on their holding, using the new skills gained from working alongside the S4P adviser, others would employ a consultant which might include bulk density assessments, combined with soil texture.

8 Benefits delivered by S4P

This section summarises some of the main benefits which S4P should have helped to generate. It is important to note that the following points provide some context:

- The former South West Region amounted to approximately 10% of the UK and 20% of England (Wikipedia 2017).
- The South West's economy is more reliant on agriculture than any other English region (Defra 2013).
- Agriculture accounted for 2.22% of all jobs in the former South West Region. This was nearly twice the percentage for England (1.14%) (Defra 2013).
- Agriculture contributed £1,265 million to the South West economy in 2011, accounting for 1.25% of economic activity (Defra 2013).
- 8% of the South West was classified as Less Favoured Area for agricultural production. (Defra 2013).
- Annual average farm business income in the South West was lower than the national average by over £14,000. (Defra 2013).
- One third of the South West was designated for its landscape quality (National Parks & Areas of Outstanding Natural Beauty (AONB) (see map at Appendix X) and almost a quarter of all the national Sites of Special Scientific Interest (SSSI) are located in the South West
- There are 6 European Marine Sites in the South West (Fal and Helford cSAC, Plymouth Sound and Estuaries cSAC/ SPA, Exe Estuary SPA, Chesil and the Fleet cSAC/ SPA, Poole Harbour SPA, Severn Estuary pSAC/SPA). Several of these sites have concerns relating to nutrient enrichment from agriculture. (Marine Biological Association UK, 2003).

The figures in this section attempt to estimate the changes brought about by the S4P programme. However, S4P was not the only initiative attempting to drive improved soils practice. Additionally, it is not known how participants would have behaved in the absence of the project. For example, there has been a general decline in fertiliser use since the 1980s which may indicate that some of these farms would have changed practice anyway, although levels seem to have been fairly stable since 2010 (Defra, 2017a). It is therefore not possible to determine how much of the impacts estimated below can be attributed to the S4P programme.

Agricultural industry

Reduction in production cost for participating farm businesses

One of the main objectives of the S4P Project was to deliver advice and training to help farmers to save production cost whilst also benefitting the environment. Improved soil nutrient management planning should have helped a number of the participating farmers to reduce the use of artificial fertiliser through better nutrient budgeting and the more efficient use of manures.

Based on the evidence collected by S4P 40% of the farmers, who received the 2,000 recommendations to either write or update a nutrient management plan or use a nutrient planning system such as PLANET or Manner, adopted this.

ADAS and Rothamstead reported in December 2011 that adopting a fertiliser recommendation system should produce, on average, a saving of £3,100 per year on a mixed farm, £2,200 on a dairy holding and £3,800 per year on an arable farm by reducing the amount of fertiliser used. As shown in figure 5, farms targeted by the S4P programme were fairly evenly spread across the different types, which is representative of the South West region. Average savings across all farm types would therefore be expected to be in the region of £3,000 per year per farm.

However, the ADAS and Rothamstead figures are based on national averages. Average farm size in the South West region is about 80% of the England average (Defra, 2017b) so cost savings would be expected to be less. Assuming savings are 80% of the England average, this would represent a cost saving of £2,400 per farm per year

Therefore if an average estimated annual saving of £2,400 was multiplied by the number of farmers who were recommended it (2,000), then multiplied by the percentage of farmers who adopted the recommendation (40%), then an approximate business cost saving of around £1.9m per year might have been generated by the final year of the programme. It is expected that the change in behaviour, and therefore cost savings, would continue beyond the life of the programme.

Longer term benefits to farm businesses and the environment

Longer term benefits should also have been gained from higher yielding, better quality crops and the reduction in fertiliser usage which should be gained from the improved soil management techniques. Based on the evidence provided by S4P follow up advisory engagement, about 60% of the 1,550 farmers who were recommended to rectify soil compaction went on to implement this advice. Longer term benefits might also include the additional gross margins achieved after more precision farming equipment and more efficient agricultural machinery might have been purchased by the participating farmers or used by hiring agricultural contractors.

S4P helped “signpost” many farmers to alternative sources of public funding. This included the SWARM Small Capital Grant Scheme, the Farm and Forestry Improvement Scheme and the Catchment Sensitive Farming Capital Grant Scheme. There would also have been longer term benefits to the environment as a result of the reduction of ammonia emissions which many of the recommendations in this project would have helped to achieve. These recommendations might include the use of shallow injection or band placement application for spreading slurry. Based on the evidence gained from follow up advisory engagements, it appears that about 25% of the 925 farmers recommended by an S4P delivery adviser to adopt either a band or shallow injection slurry system, went on to do so.

Helping farmers to tackle specific problems

Some farmers engaged with S4P when they had a specific problem for which they wanted impartial advice. For example a farmer might have experienced reduced crop yields in certain fields or might have been considering how best to adapt to and comply with a NVZ slurry storage requirement. S4P advisers often helped identify solutions through discussions with the farmer and helped them to place a priority on the tasks, based upon cost and benefits.

Many farmers would then go on to the private sector for future advice, providing benefits to the farm and to the growth of the industry as a whole.

Increased farmer skills and confidence

Based upon the feedback gained by S4P 99% of the farmers indicated that, after receiving on-farm advice from the project, they expected to apply the skills which they had learnt. 93% of training participants at S4P group events indicated that they expected to apply the skills which they had learnt. For grant claim purposes the project used an average between the two of 96%.

Increasing the skills of participating farmers should also have helped some to become more confident and competitive by, for example, having a better understanding of crop requirements through nutrient budgeting and using organic manures more effectively. This should then also have helped some to become better informed and more confident when dealing with professional fertiliser salesmen and agronomists, some of whom might have a vested interest in the inputs which they are recommending. This increased confidence would also enable the farmers to take more positive decisions in relation to the wider environment which might include entering an agri-envionment scheme such as Countryside Stewardship.

Reducing the risk to some farm businesses of receiving financial penalties

By advising farmers on the legislative framework within which they operate e.g. record keeping, there should have been a reduction in the risk of financial penalties (fines) and damage to the reputation of the participating farm businesses from non-compliance.

Enhanced reputation of the agricultural industry

By some farmers adopting best practice and complying with legislation, as a result of the advice and training provided by S4P, the reputation of the agricultural industry should have been enhanced.

Wider economy

The S4P Project not only delivered benefits to the farmers who engaged with the project but to many other parts of the economy plus positive knock-on benefits to wider economy and society.

Other public funding

The need for and pros and cons of using certain equipment were discussed with many farmers during the advisory visits and would only have been recommended in a written report, following a visit, if deemed appropriate. Therefore the farmers could submit these reports to SWRDA as a way of helping demonstrate the need for the item. SWRDA confirmed that this helped increase the quality of the grant applications and also helped its staff, responsible for administering the various schemes, time and money in assessing the "need for grant".

Supporting non-farming businesses

S4P directly supported many non-farming businesses such as agricultural consultancy companies, paid to deliver technical farm advisory visits, the venues and caterers of group training events and the company paid to analyse over 3,500 soil samples. The project spent in excess of £1.5m on these services.

Many of the actual external S4P advisers and trainers were self-employed. It is assumed that the services of these advisers and their companies would have been used more in the future as a result of the "introduction" opportunity provided by S4P.

Another way in which business was supported included the voluntary involvement of companies such as machinery dealers, some of which helped to organise a number group training events or provide a guest speaker at others.

It is considered that machinery dealers and suppliers should also have benefitted from the increase in sales of farm equipment which was recommended by the S4P advisers. Such equipment included precision farming equipment, slurry separators and more accurate slurry applicators. Other beneficiaries from this might have also included banks and finance companies which the farmers might have used to help fund the purchase of the equipment.

Figure 16 below shows how many times these items might have been purchased, based on the number of times recommended and multiplied by the approximate number of times implemented. These figures have then been multiplied by the estimated cost per item.

This indicates that machinery dealers and machinery suppliers may have benefitted from the increase in sales of farm equipment, recommended by S4P advisers, by up to £20m. In order to estimate the actual increased expenditure it would be necessary to understand the expenditure that would have been made in the absence of the programme. For example, if farms would have purchased alternative machinery then the benefit to machinery dealers and suppliers is the difference in expenditure on the precision equipment relative to non-precision, rather than the full expenditure.

Figure 16: Estimate of farmer's spend following receipt of S4P recommendations

Recommended investment	Number of recommendations made	% of times implemented (based on S4P follow up advisory engagement)	Estimated number purchased (based on times recommended multiplied by % of times implemented)	Estimated cost of item based on authors knowledge (£)	Approx. total value (£)
Precision farming equipment (e.g. GPS guidance systems, variable rate fertiliser spreaders, light bars etc.)	2,708	53	1,435	10,000	14,350,000
Slurry separator	151	29	44	15,000	660,000
Trailing shoe, dribble bar, and trailing hose plus new tankers	668	31	207	20,000	4,140,000
Slurry injectors	257	22	56	15,000	840,000
TOTAL					**19,990,000** **Say £20m**

Therefore if the direct project spend of £1.5m is added to the £20m estimated above for machinery dealers and suppliers an additional economic impact of up to **£21.5m** might have been gained by non- farming businesses as a result of the S4P Project.

The wider rural economy and environment

S4P carried out targeted promotional campaigns in Water Framework Directive (WFD) failing water bodies and land surrounding certain Sites of Special Scientific Interest (SSSIs).

An example of a recommendation made by the S4P Project to farmers was fencing against water courses when cattle might have previously been allowed to enter to drink. The main benefits of this type of fencing would usually be gained outside the farm business; whereas the farmer would have to pay for the fencing and also provide an alternative source of water. The main benefits to the watercourse include:

- Less e-coli and other livestock derived bacteria entering the water.
- Less nitrogen entering the water.
- Reduced disruption to the river / stream bed, which may have previously caused sediment to become suspended and travel downstream.
- Reduced disruption to the river / stream ecology.

The improvement in such watercourses could also benefit businesses that draw an income, directly or indirectly from them. These include shellfish businesses, coastal businesses associated with bathing waters and those, which depend on a healthy environment for their continued success such as angling shops and tourism businesses.

Other examples where wider benefits would have been gained as result of farmers adopting S4P recommendations might be local residents and holiday accommodation providers who would experience less smells as a result of a precision slurry application system being adopted by a farmer. This investment could also reduce ammonia emissions which would also contribute to the government target contained in the Climate Change Act 2008 of helping to cut emissions of greenhouse gases to 80% below 1990 levels by 2050 and smells.

About 4,000 people connected with, and influential over, the rural economy attended training events but were not able to register as direct beneficiaries because they did not have a holding number. These included land management advisers, agronomists, agents and agricultural students etc. It is considered that these beneficiaries would also have influenced the management of many other farmers and farm land, other than those recorded by the project. S4P also supported the employment and improvement in skill levels of Natural England staff engaged in delivery, management and administration of the project. A number of these staff were recruited on fixed term contracts and others were from the existing cohort of staff. At the start of the project the staffing consisted of the project manager alone and, at its peak in 2011/12, was around 11 full time equivalents.

Other beneficiaries in this category could include the employees and families of the farmers whose positions might be more secure as result of the savings or increase in business income which their employers had achieved. These individuals might feel more confident to spend as a result.

Reduced maintenance cost of rural infrastructure

S4P provided advice and training to farmers which helped them to increase water infiltration into their soils and thereby contribute to reducing the volume of water run-off and associated soil erosion. This in turn should have helped to reduce the occurrence of flooding, improve road safety, by reducing the volume of soil and water on roads and reduced the liability of farmers and the need for insurance claims, the clearance of roads and public drainage systems which might have been blocked.

Flooding of property and damage to council roads in the UK, often attributed to poor soil management in the agricultural industry was estimated to cost £29 - £128 million per year (based on 2004-05 values by O'Neill, 2007). The former South West Region was estimated as being approximately 10% of the UK by land area.

Although it was not possible to estimate the extent to which the S4P programme may have reduced the risk of flooding and associated damage, this provides an indication of the extent to which it is an issue across England.

Reducing the damage caused by pollutants

S4P provided advice and training to farmers which should have led to a reduction in the volume of silt, N & P in run-off water and should have directly benefited water companies and others involved in the provision of safe drinking water. Indeed, a number of projects, seeking to improve agricultural practices, have been designed in conjunction with water companies to help reduce water company treatment costs.

About 70% of the deterioration in water quality was believed to be related to agriculture. 70% of nitrogen, 50% of phosphorous and the majority of silt, entering UK waters was also thought to be derived from agriculture. Water treatment costs were estimated at £322 - £627 million per annum across the UK. (O'Neill, 2007).The former South West Region was estimated as being approximately 10% of the UK by land area.

Although it was not possible to estimate the extent to which the S4P programme may have helped improve water quality, this provides an indication of the extent to which it is an issue across England.

9 Lessons learnt from delivering the project

It is sometimes said that new projects are developed without learning the lessons from previous projects. Therefore the lessons learnt from delivering the S4P Project have been captured following feedback gathered as follows:

- Various discussions amongst the S4P project team, (including the Project Manager, Assistant Project Manager, 8 delivery advisers and 2 support staff).
- From the external delivery contractors during their “balanced scorecard” review exercises, delivered through the former Farm Advice Training & Information (FATI) Framework.
- From former delivery staff, partners and stakeholders during an event held at the NFU Offices, Agriculture House, Pynes Hill, Exeter on 12 March 2014.

These lessons, which do not have written evidence to support them, are summarised below using the following sub-headings:

- Project management and staffing
- Project promotion
- Project delivery
- Partnership working
- The use of contractors
- Project outputs
- Customer feedback

Project management and staffing

Changes in the staffing of the project confused some customers and also resulted in reduced staff morale. Therefore, where possible, try to aim for a stable delivery environment and a project period which is sufficiently long to attract good staff to join and to stay for a “good chunk” of time.

There were benefits in terms of customer rapport, quality of advice and credibility of having staff who were based locally and also had knowledge of the local environmental and agricultural issues.

It is important that the funder’s reporting requirements are fully understood and that the time and cost incurred in complying with these are accounted for when developing the project.

It was better when the staff who drafted funding claims had worked on the project as opposed to them being remote.

Project promotion

When trying to influence farmers it was important to carry the right brand, use farming & business related terms, including the term “profit” in the project name.

If the product or service on offer is 100% subsidised, don’t be afraid to say so. However make it clear that someone is paying because offering a product or service described as “free” can de-value the offer in some customer’s eyes. The downside of not charging for advice and training is that some farmers withdrew at late notice from a farm advisory meeting or did not turn up for a training event. Having to pay a fee or deposit might have reduced this happening but would have involved an administration cost.

It was useful for this advisory project to be connected to the provision of a grant scheme in order to help promote take up and also to help subsidise the cost of implementing relevant investments. However the balance between the advice and grant support was critical to ensure that the project offered the greatest benefits.

A valuable incentive to participate in the project was important. The provision of the free analyses of 5 soil samples, not connected to the sale of a product, proved useful.

As the advice was truly impartial, it was important to promote the fact.

Machinery dealers, agronomists and farm suppliers were used to promote the project. When accessing farmers, through such third parties, there was a risk of the project's values and messages being diluted e.g. losing the reputation of impartiality for example by machinery dealers possibly promoting items which they wanted to sell rather than what is needed by the farmer.

Project delivery

Changing farmer's behaviour was easier to achieve through the one to one advice as opposed to the group training. This is because the advice could be tailored to the individual farmer's needs whereas this was more difficult in group scenarios.

Having a project available only in certain areas meant that some farmers, who were located outside of the target area, became disappointed when they were unable to benefit from the support on offer. This resulted in some negativity for the project and its host from those farmers. Therefore, where possible, the product or service should be open to as many farmers as possible and take-up encouraged in priority areas through promotion such as mailings and holding events.

The R4F project promoted the benefits of allowing the farmers to choose their own adviser, from an accredited list. The S4P Project felt that this approach extended the process and could have lost the benefit of "outside eyes" and an impartial view being gained. The key requirements were to provide an adviser suitable for the farm business who could provide a quality service and could tailor their advice to the farmer's requirements.

It was beneficial for the project to use both in-house and contracted advisers. This was because:

- The in-house staff set the tone for the delivery of the project.
- In-house advisers learnt from the external advisers and vice versa.
- External advisers were more flexibly deployed.
- It was assessed that in-house advisers provided better value for money per beneficiary (Another Natural England review of the FATI catchment partnerships found similar).
- External advisers promoted the project to their clients.

Group events are a good way of promoting discussion between farmers and providing peer pressure to some. They are also a cost effective way of engaging farmers.

Follow-up advisory visits were introduced at least 2 years after the first visit because:

- It allowed enough time for some of the initial recommendations to be implemented.
- It provided the opportunity to update the farmer on changes around technical and regulatory issues.
- It provided the project with the ability to assess take up of the initial recommendations
- It promoted take up of other elements of support available through the project e.g. events, referrals to partner projects.
- It demonstrated that the project was still interested in the farmers who had been visited.
- It encouraged further implementation of the initial recommendations.

Not every farmer accepted the offer of follow up advice - some had retired since the first visit, some were too busy and some did not see the benefit. Therefore follow-up advice should only be carried out where the farmer is willing and the advice is likely to be well received.

Take up of a follow up advisory engagement was usually higher when offered by an adviser who was able to sell its benefits.

Partnership working

It was essential to work closely with other projects and initiatives in order to promote each other's offer. However, having a number of projects delivering advice in the same area sometimes caused confusion and frustration to some farmers. The idea of a 'single person driving up the farm track' is unrealistic. S4P found that most farmers preferred an adviser who understood their specific soil, manure and nutrient issues rather than having a generalist.

It was important to avoid overcomplicating the working arrangements with partners and to be business focussed whilst working together. Good communications between all partners was vital.

The use of contractors

It was considered important, where possible, to maintain a regular flow of contracts (possible work) in order to retain advisers in certain rural areas.

When issuing tenders, where payment for delivering group training events was linked to number of attendees, it was important not to set the targets too high. This was because it discouraged some companies from bidding, due to the risk of not being able to achieve the target. However the ability to offset low attendance at one event, against higher attendance at others provided some suppliers with reassurance.

It was considered that the quality of previous performance should be properly reflected in the scoring of subsequent tenders.

Contracts were front loaded with quality assurance (QA) exercises, such as joint visits and review of written reports, so that lessons could be learnt and feedback provided in the early stages of contract delivery to set the standard for future delivery. Spot checks, or the prospect of spot checks, later on in the contract helped to ensure that the standard of delivery was maintained. It was important to plan the QA of delivery before the contracts started.

Regular contact with the supplier's contract manager was important to ensure full and timely delivery to the required standard. Some contract managers were more accessible and responsive than others, and the best methods of communication varied, but developing a good working relationship with them, early on in a contract, went a long way towards ensuring the timely delivery of a high-quality service.

Project outputs

Signs of soil compaction were found, in at least one field, of 63% of all farms visited. This applied to different farm types and across most of the region except where chalk soils were found. Therefore it is considered that the digging of shallow soil pits with the farmers to look for signs of soil compaction should be built into future advisory projects if connected with soils, manures and nutrient management.

It was important to monitor the implementation of recommendations to ensure that the project was achieving its objectives and not just meeting its numerical targets.

The project outputs tended to focus on quantitative aspects of delivery such as the number of beneficiaries. The wider benefits tended to be overlooked as they were less easy to measure. In the future it might be beneficial to give more weight to the qualitative aspects of project delivery by assessing some of the benefits and attaching more importance to customer feedback rather than just numbers.

Targeting 25% of S4P Project funding and outputs to Cornwall and the Isles of Scilly proved challenging due to the size of demand and competition from other projects. It may have also resulted in customer fatigue in that area and some cynicism elsewhere in the project area.

Customer feedback

The opportunity for advisers who had regular contact with farmers to provide feedback to the bodies which designed and managed the grant schemes was beneficial.

Many farmers felt that they needed ongoing support to understand and comply with NVZ and Cross Compliance regulations; others imposed restrictions on themselves over and above the requirement in order to be on 'the safe side'.

It is important to use straightforward practical messages in order to encourage farmers to engage with the project.

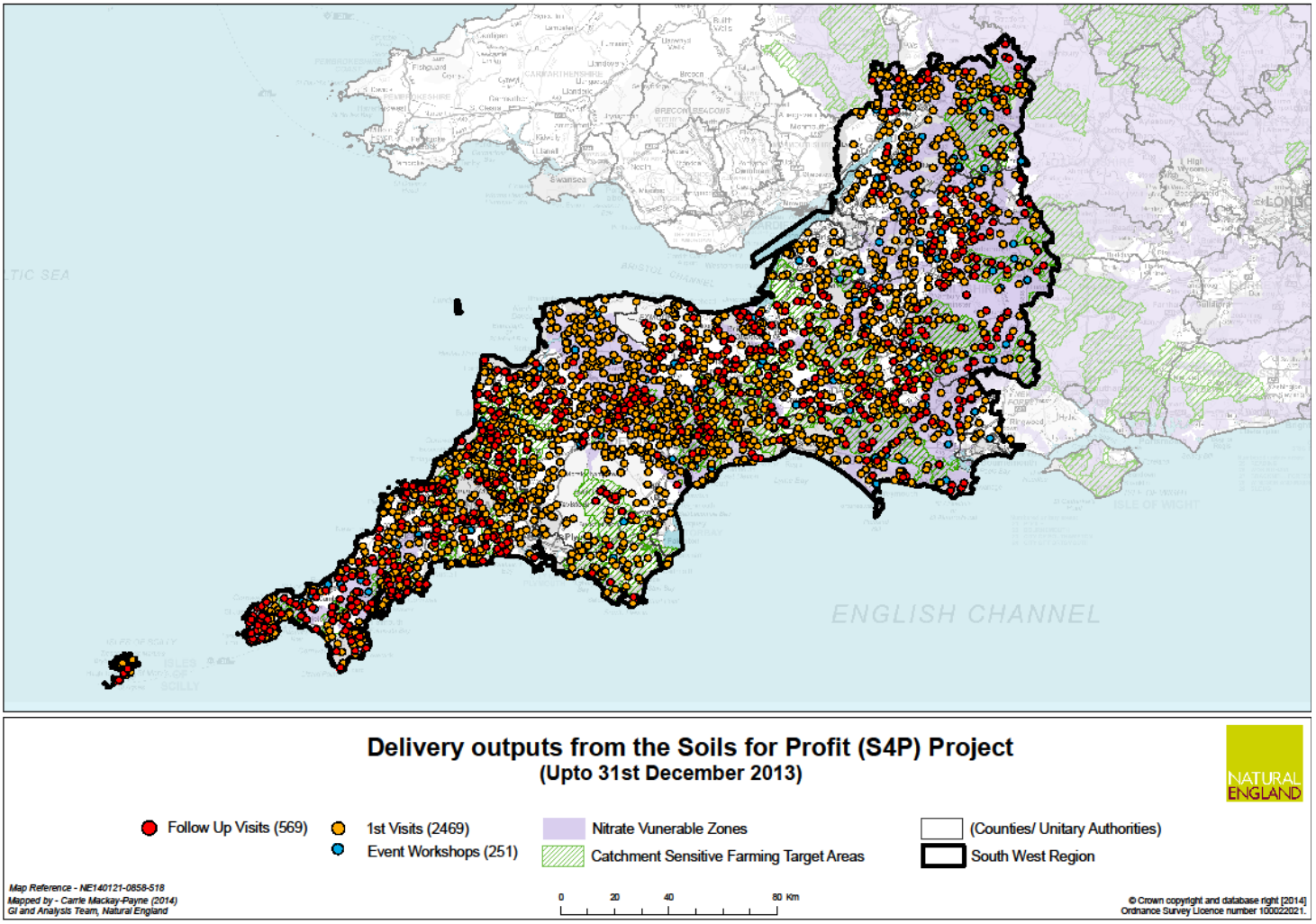
Many farmers did not appear to follow the principles of nutrient budgeting and applied the same amounts of fertiliser year on year despite existing soil nutrient levels and crop requirements. Therefore it is considered that the principles of nutrient budgeting should be integrated into other projects and schemes.

Breaking recommendations down into economic and environmental outcomes and then classifying them as high, medium and low pay back was welcomed by many farmers and advisers.

Offering advice and training on a voluntary basis was better than 'forcing' farmers to take it. However, as well as having a 'carrot' e.g. economic benefit it was also useful for some farmers to have the possibility of a 'stick,' in the background in order to incentivise them. This is because farmers are different and motivated by different stimuli. Therefore it was important for the advisers to strike the right balance between the 'carrot and stick approach' as quickly as possible upon engaging with the farmer.

Demand appears to exist from farmers for further delivery of high quality, impartial, free advice and training focussing on the management of soils, manures and nutrients.

Appendix I Indicative map showing delivery across the SW Region



Appendix II – Selection of photographs showing S4P delivery

Natural England Soils for Profit Project adviser demonstrating the assessment of soil texture to a farmer during a S4P On Farm Review of Soils, Manures & Nutrients in Somerset

Natural England Soils for Profit Project adviser assessing soil in an arable field during a S4P On Farm Review of Soils, Manures & Nutrients in Dorset

Demonstration of a tractor & fertiliser applicator being driven between trays so that the applicator can be assessed for evenness of fertiliser spread and then calibrated if necessary.

Slurry tanker with trailing shoe applicator which had been recommended to farmer by S4P during a S4P On Farm Review of Soils, Manures & Nutrients and also grant funded by SWARM Small Capital Grant Scheme.

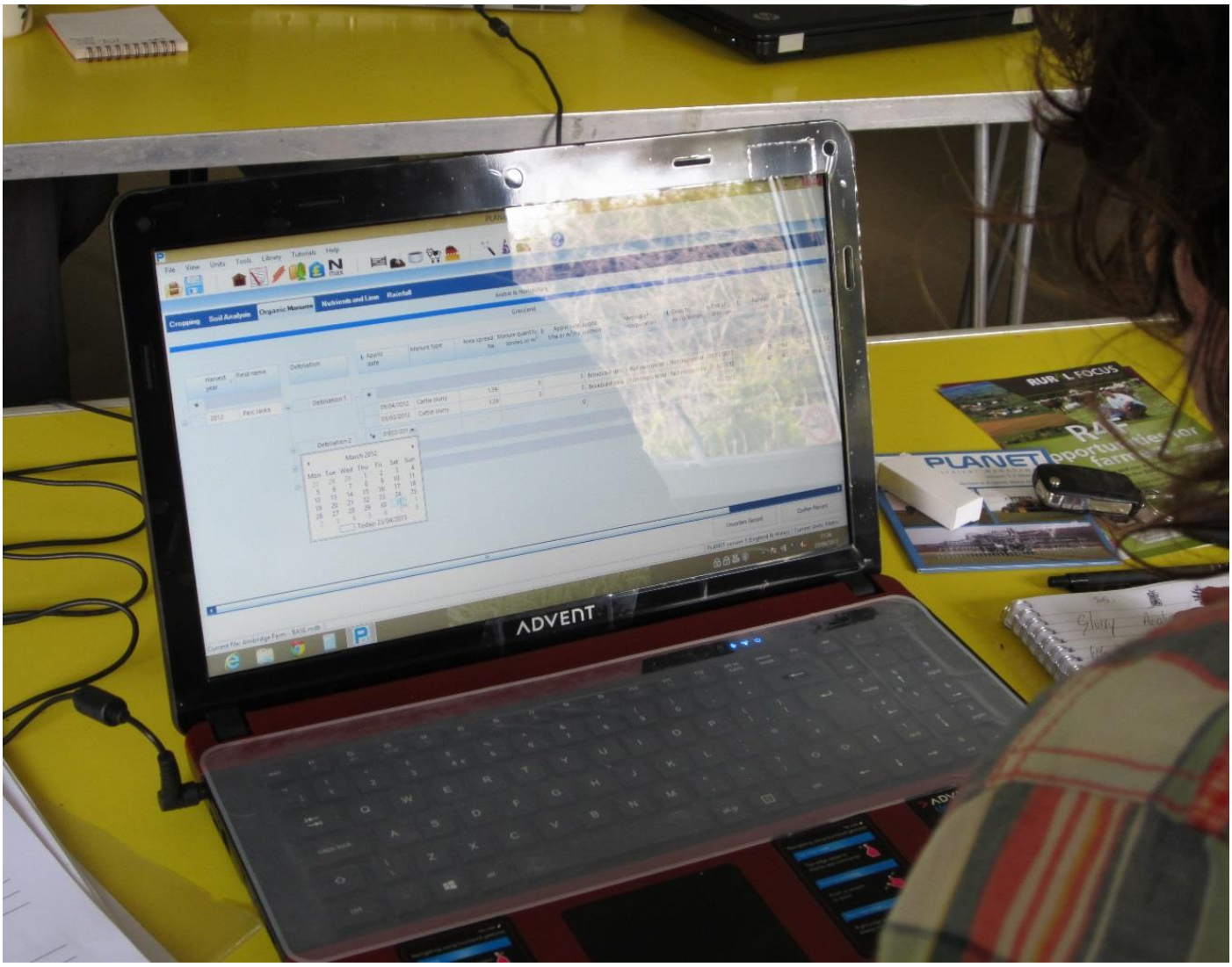
Blades of a grassland aerator.

Slurry injector injecting dirty water to field via an umbilical system on the Blackdown Hills.

Soil erosion caused by water in an arable field.

Natural England Soils for Profit Project adviser demonstrating to a farmer how to assess compaction during a S4P On Farm Review of Soils, Manures & Nutrients in Devon

Indicating root depth in a shallow soil pit



Laptop being used by a farmer during a Soils for Profit Project Nutrient Planning Workshop using the PLANET package.

Carefully digging a sample of soil during a Soils for Profit Project Farming More Precisely training event for students at Cannington College, Bridgwater, Somerset

Demonstrating to a group of students how to remove a sample of soil to assess it for compaction during a Soils for Profit Project Farming More Precisely training event at Cannington College, Bridgwater, Somerset

Rear view of a tractor and grassland aerator working in a grass field.

A soils expert demonstrating how to dig a soil inspection pit to a group of farmers during a Soils for Profit Project farmer training event on Bodmin Moor, Cornwall.

A Sward Lifter being demonstrated to a group of farmers during a Soils for Profit Project farmer training event on Bodmin Moor

A field after a crop of maize has been taken which shows signs of the soil being capped and prone to soil erosion.

A Soils for Profit Project adviser showing a worm on a lump of soil during an advisory visit in Cornwall.

A group of farmers receiving a presentation during a Soils for Profit Project training event.

A Soils for Profit Project adviser showing the rooting structure of a sample crop.

APPENDIX III – An anonymised S4P On Farm Review of Soils, Manures & Nutrients

Direct Dial: XXXXXXX
Email: XXXXXXXXXXXX

Address...

DATE

Dear

SOILS FOR PROFIT (S4P) PROJECT
SOUTH WEST AGRICULTURAL RESOURCE MANAGEMENT (SWARM) INITIATIVE

Following your Soils for Profit (S4P) Project advisory visit please find enclosed two copies of a report summarising the main conclusions and recommendations.

Section 7 of the report outlines various sources of other help, which might include the Farm & Forestry Improvement Scheme (FFIS) and the Catchment Sensitive Farming (CSF) Capital Grant Scheme, both of which target soils, manures & nutrients. Therefore should you be eligible and decide to apply to one or both of these schemes the attached report may provide suitable evidence to support your application. You are therefore recommended to keep this report safe for such purposes should they arise.

A feedback form and stamped addressed envelope are also enclosed. Your time to provide feedback on the service you have received through the Soils for Profit Project would be appreciated as it will allow the project to further develop and continue to receive funding.

If you have any queries regarding the contents of your report, over the next 4 weeks, please contact me on XXXXXXXX after this time please address your queries to Natural England on 0300 060 1244.

Yours sincerely

ADVISER NAME
S4P Deliverer on behalf of Natural England

Encl: 2 x On-farm advisory report
1 x Feedback Form and stamped addressed envelope

European Agricultural Fund for Rural Development:
Europe Investing in Rural Areas

SOILS FOR PROFIT (S4P) REVIEW

OF

SOILS, MANURES AND NUTRIENTS

Farmer name	
Address	
c.p.h. number	
Telephone number	
Mobile	
E mail	

Written by:	
Signed:	
Organisation	On behalf of Natural England
Tel	
E mail	
Quality Controlled by:	

Please complete dates. Not doing so may result in delays to payment

	Date
Commissioned by Natural England	DD/MM/YYYY *This is the date NE sent the farmer contact details to Contractor. Advisers please liaise with contractor project manager for this information if not provided with farmer details.*
Date of visit	DD/MM/YYYY
Date report sent to farmer	DD/MM/YYYY

European Agricultural Fund for Rural Development: Europe Investing in Rural Areas

Summary

This report concludes that the soil structure in the inspected fields is generally good. Regular inspection with a spade, as well as continuing to carefully manage the timings of operations and rotating the grass leys, will help to maintain soil condition which should help further improve yields whilst reducing environmental impacts such as run-off etc.

Manure is already treated as a valuable nutrient source on this organic farm and the adequate slurry storage allows timely application. To further improve nutrient efficiency it is recommended to use a trailing shoe slurry applicator which should helped reduce ammonia loss and improve N efficiency.

Increased soil sampling would also help achieve more targeted manure applications and PLANET would be beneficial for general nutrient based record keeping, including NVZ record keeping.

The possible grant aided options which have been recommended in this report are a trailing shoe slurry applicator and an on farm slurry testing kit.

2. Introduction

South West Agricultural Resources Management (SWARM) is an initiative involving Natural England, Environment Agency (EA), Rural Focus and Defra's South West RDPE Delivery Team The initiative is working with farmers in the South West Region to help them manage their resources in a more efficient way, thereby saving money, whilst also benefiting the environment.

Natural England is working in partnership with the EA to deliver the Soils for Profit (S4P) Project element of SWARM, which includes training events, workshops, demonstrations, on farm advice etc.

This S4P On Farm Resource Review focuses on the management of soils, manures and nutrients and is written following a visit and meeting on (date) between (*insert name of consultant(s) / S4P Project Delivery Officer(s)*) and *(please insert the names of all persons met)*.

This report is produced for *(please insert the farmers name).* The conclusions and recommendations included in this report reflect the information obtained at the time of the visit.

3. Overview of Farm Business

The Farm currently extends to 123 ha (305 acres) of organic land with additional land (up to 80 ha) being rented in each year. Current cropping comprises of 20 ha of triticale, 4 ha of peas and barley and the majority of the remaining land is either medium or long term grass leys that are part of the rotation.

The main farm enterprise is the 140 organic cow dairy herd averaging approximately 7,300 litres per annum and the replacement heifers. The farm is currently developing a new shed for cubicle housing and a new shed for loose housing. The milking cows are going to be housed on sand based cubicles throughout the winter with the remaining cows and young stock housed on straw in covered yards, producing farm yard manure (fym).

The majority of the land on the main farm is relatively flat to gently sloping, although there is a small area of steep land that remains as permanent pasture and is only utilised for grazing. The soils across the farm vary considerably from heavy clays to freely draining loams over limestone.

The Farm is situated within a Nitrate Vulnerable Zone (NVZ) and Mr Farmer already receives advice from a farm consultant on his NVZ requirements. The Farm is within the Somerset Levels and Bridgewater Bay target catchment for the England Catchment Sensitive Farming Delivery Initiative (ECSFDi), no grant funding has been received from this programme to date. 91 ha is entered into the

Organic Entry Level Stewardship (OELS) scheme. A Countryside Stewardship (CSS) agreement ends in 2011.

The Farm does not have any historic features or SSSI.

Mr Farmer wishes to further improve the efficiency of running the farm, including the use and application of organic nutrients to obtain optimal nutrient utilisation.

4. Soils

The soils found at The Farm vary as per Figure 1 below. The soil associations are the Evesham 1 Association which is described as “slowly permeable calcareous clayey soils”, Sherborne which is described as “shallow well drained brashy calcareous clayey soils over limestone” and Elmton 2 association is described as “shallow, well drained, brashy, calcareous, fine, loamy soils over limestone”. There is also an area of South Petherton soils which is described as “deep well drained silty soils - some over soft rock”.

These soils require different management as the clay based soil has the potential to be seasonally water logged and the increased risk of structure damage whereas the freely draining brashy land can pose other risks such as leaching and nutrient loss.

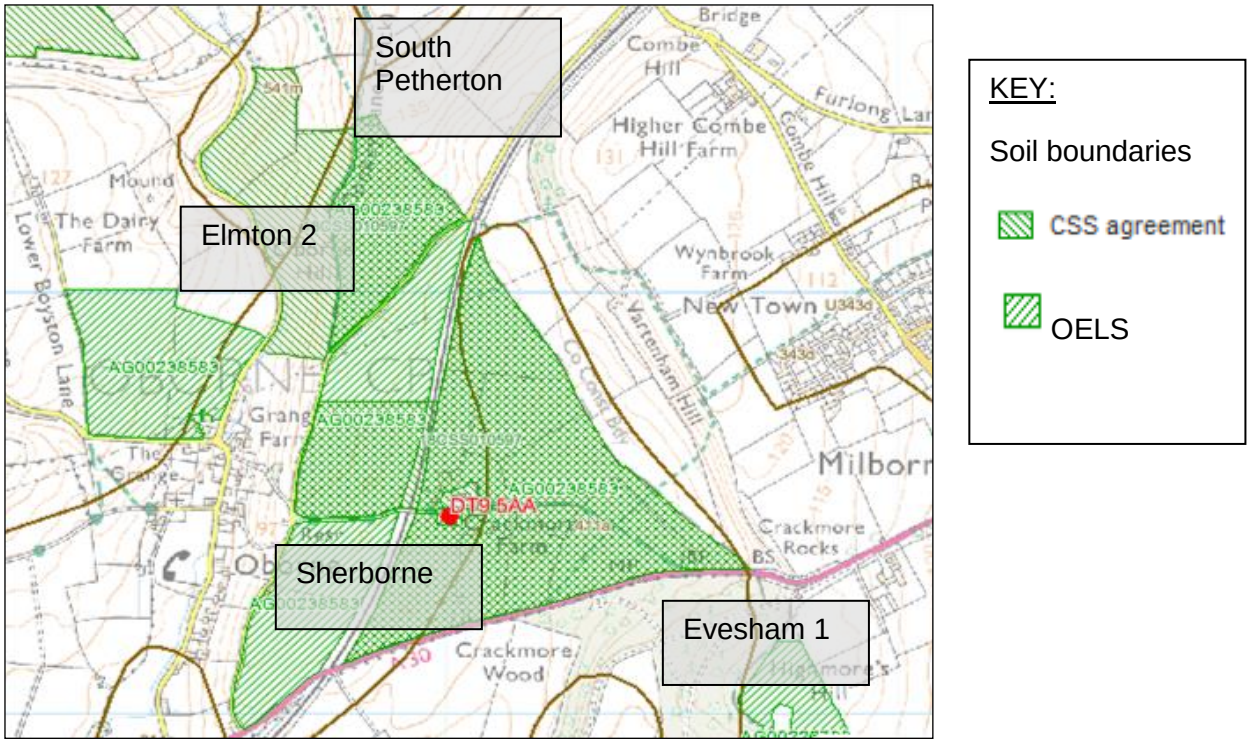


Figure 1: Soil associations at Home Farm

Mr Farmer has recently updated his Soil Protection Review (SPR) which highlighted ways to improve soil management. Changes with the 2010 SPR were discussed on farm including the map to highlight potential risk areas and accessing water logged land. A basic soil management plan is also in place which identified the soil types, steepness of slope, soil structures and potential threats in each field. Updating and implementing the soil management plan should lead to better levels of productivity being achieved and environmental standards being improved.

Considerable care is already taken to manage the soils as they are the basis of an efficient grazing system. Mr Farmer understands the importance of good soil structure and reduces the risk of causing compaction to the soils by housing the grazing stock during wet periods and keeps trafficking on the

land to a minimum. Increasing the slurry storage on farm has ensured that manure application does not need to be undertaken when the soils are wet and at a higher risk of being compacted. Other than cultivations and natural soil changes there are no processes in place to rectify structural damage that has occurred in previous wet grazing seasons.

Soil profile inspection pits were examined in 3 different fields to assess soil structure, and indicators of soil compaction. Observations were also made in relation to possible run-off and erosion risk.

Field 1: Car Park

This flat field is a long term grass ley that was established about 7 years ago. The ley is predominantly used for grazing because of its close proximity to the farm building; however, this field has been used predominantly for car parking in recent years. The continuous grass coverage and the fact that the field is only gently sloping leads to a minimal risk of run-off or erosion.

The soil texture was classified as a silty clay loam over slowly permeable clay at a depth of approximately 30 cm. A soil profile pit was dug near the centre of the field to identify if soil compaction was limiting performance. Figure 2 highlights a well developed soil structure that has different size aggregates which are allowing good aeration and drainage to the soil which would be allowing the grass to effectively utilise nutrients.

Figure 2: Soil Profile in Car Park

Earthworm presence is a good signal of soil health, although none were identified on the day of the visit, worms will go deeper when soils are drier. 20 – 25 worms of different size, which are a healthy brown colour, is the target number to be observed in a profile pit to reflect a rich microbial food source. Soil microbes are the digestive system to plants and breakdown or release nutrients contained in organic matters to a plant available state that is used during the vegetation processes.

This grass pasture will maintain its structure naturally through earth worm activity, also natural fracturing processes both through the large network of roots and when the soil clay content shrinks and swells.

Care needs to be taken to ensure that grazing, manure applications and silage making are not carried out on the land when soils are in a moist plastic state. If they are there is the risk of compressing and compacting the soil, which in turn reduces the productivity of the sward and increases the likelihood of nutrient run-off.

Field 2: Barn Field

This field is a gently sloping field (3 - 6°) that has been in grass for the last 4 to 5 years. This field is again relatively close to the dairy housing and is therefore predominantly used for grazing, after first cut silage. A soil profile pit was dug in the field which identified a medium stone brash, silty clay loam to depth.

The soil structure in this field was found to be more crumbly throughout the profile than the first field. The soil was made up of different sized aggregates and some organic matter was visible in the sub-surface layer. Strong rooting was seen in this field to a good depth. Although again there were only a few visible signs of earthworms the soil crumbled easily, with vertical fissures being present rather than horizontal ones. The packing density was low and there was good aeration and drainage.

The use of the penetrometer and the digging of a profile pit both identified that soil compaction is not an issue in this field.

The good organic matter levels observed in this field are important, especially in a soil with low clay content. Organic matter improves the chemical interactions within the soil, which binds the soil particles together into aggregates and strengthens soil structure. Additional benefits of organic matter include:-

- Nutrient supply - reservoir of nutrients
- Increased water holding capacity
- Soil structure aggregation – improved structure leading to improved infiltration
- Erosion prevention - increased water infiltration and more stable soil aggregate

This field was highlighted by Mr Farmer as an underperforming field compared to similar fields but was also identified as having good physical soil structure. However soil structure is only one area of achieving optimal soil function. The correct chemical and mineral balance also needs to be maintained in order to provide the correct conditions for soil microbial activity and in turn nutrient cycling from soil to plant.

Regular soil sampling would be recommended to identify any abnormal nutrient levels that would be impeding the performance of this grass sward. Digging soil profile pits regularly in fields, especially ones believed to be compacted will also highlight if compaction has occurred and if or what mechanical operations are required to rectify the issue. Cultivations are the best time to rectify any compaction issues in grassland fields that are part of a rotation.

Field 3: 16 acres

This field is a gently sloping field that has been in grass for at least 9 years. This field is again relatively close to the dairy housing and it is predominantly use for grazing. A soil profile pit was dug in the field which identified a healthy dark coloured brashy loamy topsoil that was well structured. The stone content naturally improves the drainage of the soil.

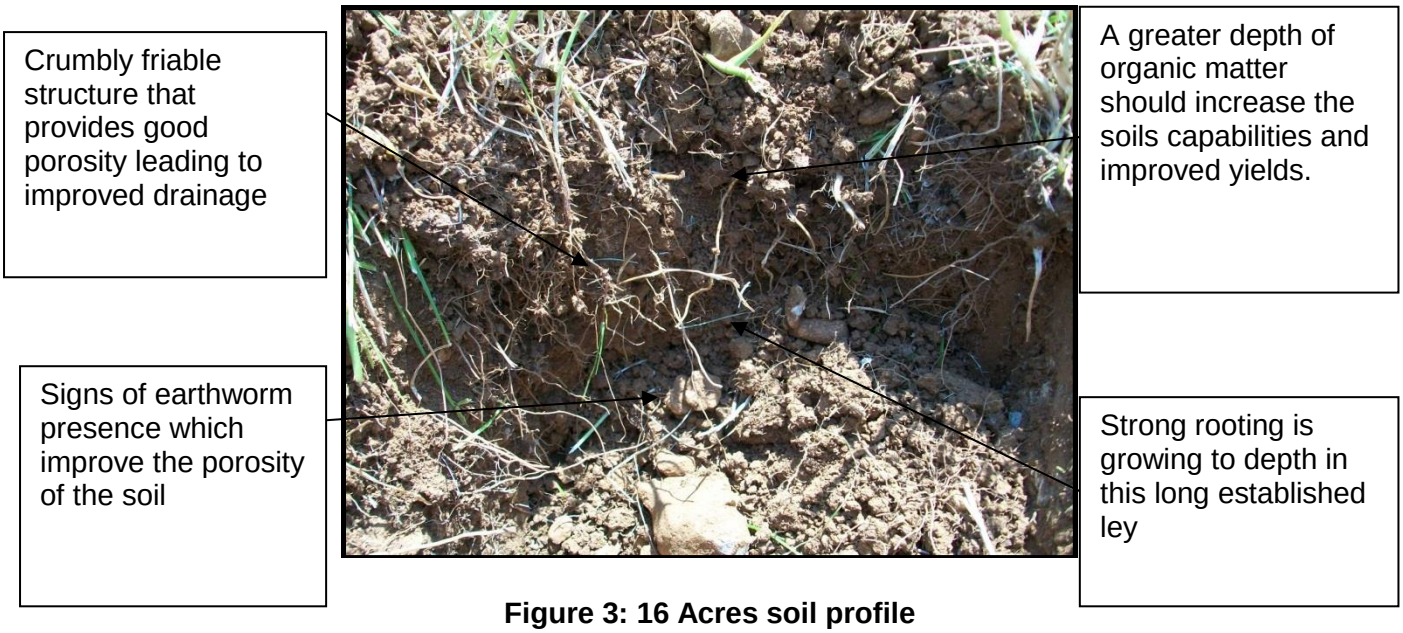


Figure 3: 16 Acres soil profile

Well developed soil structure does not only improve the drainage and rooting, it also increases the ability of the grass to utilise applied and soil nutrients. The availability of oxygen and water in the soil enhances the availability of mineralised N from organic matter and N fixation from legumes such as clover is also improved. There were a large number of strong pink nodules on the clover stolons identifying that the plant was actively generating nitrogen.

Overall the different soils observed at The Farm are identified as having strong, well developed structures. The good soil structure will be improving infiltration, aeration, nutrient utilisation and in turn grass growth.

Use of the soil management plan will be a beneficial tool in terms of timings of operations such as slurry applications and grazing times in different fields with different soils to protect the soil structures. Soil plans also highlight areas to avoid with the higher risk crops such arable crops. Continuing to carefully manage the timings of operations and rotating the grass leys will maintain soil condition which improves yield and reduces environmental impacts such as run-off.

No	Recommended change / investment *(in priority order)*	Economic cost & benefit plus estimated pay back	Environmental benefit
1	Utilise and update the Soil Management Plan	Maintaining soil structure and reducing soil erosion, therefore reducing valuable nutrient losses Short term (1 - 5 year) payback	Reduced risk of soil compaction, erosion and run-off
2	Regular inspection of soil structure with a spade	Good soil structure underpins maximising yields. Cheap and easy method to identify the need for mechanical action Short term (1 - 5 year) payback	To identify soil problems before they restrict crop yields or increase environmental risk
3	Keep grazing and trafficking (manure applications, harvesting and cultivations) to a minimum when soil is wet or water logged	Reduced risk of soil damage especially in gateways Short term (1 - 5 year) payback	Reduced risk of erosion, run-off and pollution
4	Start to rotationally soil sample fields every 4 - 5 years	Cost is approximately £15 for a standard sample and £80 for a comprehensive sample. This can lead to increased efficiency in nutrient usage, more targeted nutrient applications where needed & improved yields Can identify the mineral levels in the soils - optimum levels lead to more efficient use of major nutrients Short term (1 - 5 year) payback	Reduced risk of leaching Matching application to requirement = reduced losses of nutrients
5	Continue to rotate cultivations and the reseeding of grass leys. Rectify any compaction found at this time.	Cultivations improve soil structure. Again increased aeration and drainage which improves yields Short term (1 - 5 year) payback	Less water-logging and reduced risk of run-off of applied nutrients.

5. Manures

The storage and application of manures has been identified as a key concern at The Farm as manure is the only form of nutrients available in this organic system. There is only a limited amount of slurry so the application is targeted to the fields that are thought to require the nutrients. Application is recorded on paper based field records.

A manure management plan is in place for organic purposes. However, this needs to be looked at to see if all the NVZ requirements are met (care has to be taken because nutrient figures vary between NVZ and organic standard figures). “PLANET” was suggested to base applications of nutrients dependant on the crop requirement and also records a number of details required for NVZ purposes.

A brief explanation of the details that need to be in place to ensure compliance with NVZ requirements were discussed during the visit. These include:-

- Keeping records of planned and applied manures
- Complete risk maps and keep up to date with changes (including identifying FYM field heaps)
- Calculate whole farm N limit calculation
- Records on animal numbers and manure produced for the previous year
- Capacity compared to production calculation for storage purposes
- N Plan in terms of 2010 cropping
- N Max calculations for specific crops
- Records of imported and exported manures

Having the above records in place and the risk maps ensure timings and applications are carried out correctly. Overall NVZ requirements will make nutrient applications more accurate and targeted, making more applications when the crop will utilise the optimum amount and in turn increase yields.

All sand based slurry from this winter forward will be stored in the concrete floored earth bank lagoon. The store has the capacity to store approximately 2,000 m^3 of slurry which according to Mr Farmer is thought to be adequate to cover the 5 month storage period. Having this large storage capacity enables slurry application to be made in early spring and after each cut of silage which reduces worm kill and optimises the utilisation of the nutrients by the growing crop. More nutrients are available to the crop in the spring which leads to the increased utilisation. Storage also ensures that slurry does not have to be spread throughout the winter which reduces the risk of compacting the soil.

A possible option is to further increase storage capacity in order to reduce the amount of clean and dirty water mixing. The practicalities of covering the slurry were seen as a major drawback, however roofing over cow loafing or feed areas would reduce the amount of rainwater having to be stored and spread. It may be worth contacting the ECSFDi in relation to this idea because this could be eligible for grant aid (see section 8).

Slurry is currently applied with the farms conventional splash plate tanker or by a contractor.

Having a large amount of storage allows slurry to be applied at a low rate prior to first cut, after each cut of silage or after grazing. The planning of manure applications is efficient; however the accuracy of application and nitrogen retention could be further improved. It is therefore suggested to invest in a trailing shoe slurry applicator on a new tanker to reduce grass contamination, to improve the efficiency of N utilisation and to improve the accuracy of application. The typical Ammonia abatement of a trailing shoe slurry application is stated to be around 60% (Ball, 2010). Ball, (2010) also suggests the saving in N fertiliser when using a trailing shoe is approximately £12 - £13 /ha.

The benefits of targeted slurry application compared to a splash plate include:

- Reduced ammonia loss and odour – minimise the surface area of the spread slurry exposed to air
- Improved N efficiency = Improved yields
- Slurry deposited into the rooting zone
- Opportunities to utilise slurry in rotational grazing systems without tainting grass sward
- Longer window of opportunity for spreading – Spread 3 weeks after 1st cut silage because of reduced grass contact
- Financial savings in artificial fertiliser costs
- Improved uniformity of spread, more even distribution
- Minimise the risk of scorch and crop contamination

- Less visible operation in the countryside
- Ability to apply slurry in windy conditions

Dirty water has previously been tested on farm to identify its nutrient value. It would be beneficial to increase the frequency of testing to provide a more accurate nutrient value for the slurry being applied at that time, rather than relying on a standard book value, therefore, increasing the accuracy of nutrient planning. However, it is recommended to test the solid manures through a laboratory to provide more accurate analysis.

In terms of solid manure on farm the majority is stock piled and applied to the cultivated land prior to establishment. Incorporating the FYM into the soil as quickly as it is practically possible ensures optimal nutrient retention. Solid manure applied to bare land or stubble should be incorporated within 24 hours to reduce odour, ammonia loss and the risk of run-off (DEFRA, 2009).

NVZ Regulations state that the overall N loading capacity should be 170kgs per hectare. The calculation based on livestock numbers on the day of the visit (Appendix 1) shows that 16,883 kg of N is supplied by livestock annually on the farm and 123ha being farmed shows the farms livestock manure N loading is 137 kg/ha. Therefore, based upon this quick calculation it is considered that the farm currently complies with the livestock manure N limit. This calculation needs to be repeated in due course in order to help satisfy the NVZ Regulations which are policed by the Environment Agency.

Overall manure management is relatively efficient on farm and considering the recommendations that have been made as well as continuing to use the plan and record manure use will help to ensure correct timings, applications and amounts of manure are spread. The main recommendations to improve manure management are to consider surface applying slurry with a trailing shoe slurry attachment and to improve planning of slurry applications to improve the efficiency of N utilisation. This will improve yields and reduce the environmental risk.

No.	**Recommended change / investment** *(in priority order)*	**Economic cost & benefit plus pay back**	**Environmental benefit**
1	Ensure manure planning and records meet NVZ requirements (consider using PLANET software)	Optimum manure applications in terms of timing and amounts. More accurate use of nutrients Helps record information required for NVZ purposes Short term (1 - 5 year) payback	Reduced risk of diffuse pollution, nutrients used more efficiently leads to less risk of leaching. Less risk of oversupply of nutrients
2	Slurry sampling	Know the actual nutrient value of the slurry rather than making assumptions. This should lead to	Reduced risk of oversupply, therefore reduced risk of leaching and pollution

		more accurate applications of nutrients. Reduced need for manufactured fertiliser Approximate costs of one laboratory sample = £35 compared to an on farm test kit that does multiple samples and costs around £250 (although maybe less accurate) Short term (1 - 5 year) payback	
3	Incorporate FYM into bare soil or stubble as soon as possible after application	Reduce ammonia loss. Improved nutrient retention reduces the need for artificial fertiliser Short term (1 - 5 year) payback	Reduce odour and risk of run-off
4	A trailing shoe slurry applicator	Costs approximately £10,000 - £14,000 depending on size Benefits should include improved N efficiency & increased yields. Financial savings in artificial fertiliser costs (approx £12 - £13/ha, Ball,2010) Reduced grass contamination and scorch = increased grass intake Medium term (5 - 10 year) payback	Reduced ammonia loss and odour. Improved uniformity of spread, even distribution leading to a reduced risk of pollution. Less visible operation in the countryside

6. Nutrients

The Farm is organic, therefore only uses FYM as a nutrient source so there is no requirement for an additional nutrient management plan and the fertiliser usage during 2010 was zero.

Current records show the amounts and timings of nutrient applications. For NVZ Regulation purposes the crop N requirement (N max) needs to be identified for each different crop. To demonstrate compliance records need to be kept for each field on crop type, date sown, Soil Nitrogen Supply (SNS), crop N requirement and the amount of manure applied. Demonstrating that the crop requirement has not been exceeded.

Soil sampling is carried out when required; it is suggested to increase the frequency of this to ensure each field is tested every 4 – 5 years. Sample results should the basis for nutrient planning, to target the nutrients where they are most required. Soil sampling should ensure good maintenance of the soil nutrient balance and pH, improve crop yields and reduced environmental impacts. Additional benefits include:-

- Identifying nutrient deficiencies and excesses
- Targeting of lime, manure and fertiliser requirements
- Correcting the balance of nutrients improves nutrient utilisation
- Reducing leaching and run-off loses.

More focussed testing is suggested in problem fields to identify soil nutritional problems. This will help to maximise the production from the soils. If only basic nutrient testing is carried out the main nutrient indices such as P and K should be focussed on.

The optimal levels for grassland are:

- pH levels of 6 – 6.5 – Optimise plant growth and improves interactions of nutrients
- P levels at index 2+ – Important for root development which provides drought tolerance and allows efficient uptake of nutrients
- K indices at index 2 - essential for the transportation of nutrients and crucial in a cutting system

Mr Farmer recognises that manure is a valuable nutrient source and is therefore trying to maximise its utilisation. A calculation has been done to identify the estimated financial value of manures produced on farm compared to a theoretical purchasing of the equivalent amount of manufactured fertiliser.

Organic manures produced annually by the livestock at The Farm whilst grazing or housed contain the following amounts of available nutrients:-

- 5, 520 Kg Nitrogen (N) available nutrients with a financial value of £3,700
- 3, 280 Kg Phosphate (P) available nutrients with a financial value of £1,870
- 14, 285 Kg Potash (K) available nutrients with a financial value of £8,140

Values are based on standard plant availability figures, although the availability of nutrients will vary if soil indices are below optimum. (Values used are from RB 209 and the NVZ guidelines).

The total annual value of available nutrients provided by the manure is approximately **£13,700** based on 34.5% N at £230/tonne, Triple Super Phosphate at £270/tonne and Muriate of Potash @ £340/tonne. This shows that this valuable product needs careful management to gain optimal use and to reduce the amount of manufactured fertiliser being purchased.

Overall the utilisation of manure nutrients at The Farm is good, and to gain further efficiency in this organic system planning is suggested. Rotational soil sampling would provide a basis for targeting the organic manure which is a very valuable resource on farm.

No.	**Recommended change / investment** *(in priority order)*	**Economic cost & benefit plus pay back**	**Environmental cost & benefit**	**Eligible for SWARM grant (yes / no)**
1	Start to soil sample on a rotational basis every 4 - 5 years	Cost is approximately £15 for a standard sample and £80 for a comprehensive sample. Soil sampling can lead to Increased efficiency in nutrient usage, more targeted applications to where needed and increased yields.	Reduced risk of leaching. Matching application to requirement can lead to a reduced	No

		Soil sampling can help to identify the mineral levels in the soil - optimum levels can help achieve more efficient use of major nutrients.	losses of nutrients	

Other Sources of Help

Type of advice	What	Contact details
Group workshop events through S4P for farmers located outside of ECSFDi target areas	NVZ Soils Protection Reviews Nutrient planning Etc.	Contact Natural England on: 0300 060 1244, soils4profit@naturalengland.org.uk or see website at www.naturalengland.org.uk
Further on-farm specialist advisory support available through S4P etc. (outside of ECSFDi target areas). **Only when clear public need and benefits can be demonstrated** e.g. risk of soil erosion running into communities etc.	There is currently no provision for this advice, however if a public benefit can be identified this may be considered by the S4P project manager	*Contact Natural England on 0300 060 1244, soils4profit@naturalengland.org.uk or see website at www.naturalengland.org.uk*
Catchment Sensitive Farming (CSF)	Information on eligibility of possible grants, training events, slurry sampling and demonstrations	CSF Officer is Roy Hayes: Contact on 01278 484862 or 07814 233743
Advice under R4F e.g. farm review, group event, specialist advice	Identifying energy saving methods on farm	*Refer to Business Link on 0845 600 99 66 or visit their website – www.businesslink.gov.uk*
Latest NVZ information	Keep up to date with relevant dates, calculations and requirements	The latest guidance for farmers in NVZ's - http://www.defra.gov.uk/environment/quality/water/waterquality/diffuse/nitrate/help-for-farmers.htm
PLANET	Improved nutrient planning and record keeping	Software is available free from www.planet4farmers.co.uk Email to planet.admin@adas.co.uk Telephone the PLANET helpline on 08456 023864 (Monday – Friday 9am to 5pm) until May 2017
Code of Good Agricultural Practice		*To obtain a copy contact The Stationery Office on: 0870 600 5522 or online at: www.tsoshop.co.uk/*
Think Soils booklet: Soils assessment to avoid erosion and runoff Best Farming Practices case studies Nitrate Vulnerable Zone		*Environment Agency:* *Web: www.environment-agency.gov.uk* *Tel: 08708 506 506*

References

BALL, 2010. *Agricultural Resource Management Capital Grant Scheme 2009* – typical costs and benefits. (Natural England, Taunton).

DEFRA, 2009. Protecting our Water, Soil and Air. *A Code of Good Agricultural Practice for farmers, growers and land managers.*

Disclaimer

No representation or warranty is given (express or implied) as to the accuracy, completeness or correctness of the information provided in the delivery of these services. Natural England accepts no liability whatsoever for any direct, indirect or consequential loss or damage arising in any way from any use of or reliance placed on the information provided for any purpose.

Using and Sharing Your Information

The data controller is Natural England, Head office, 1 East Parade, Sheffield, S1 2ET.

Your information will be stored and processed in accordance with the Data Protection Act 1998. This Act gives you, as an individual, the right to know what data we hold on you, how we use it, with whom we share it and that it is accurate.

The data may be used to:-

help Natural England to further shape and deliver the Soils for Profit Project and contribute to further development of the South West Agricultural Resource Management (SWARM) initiative help Defra RDPE Delivery Team to assess an application which you might make under the Farm & Forestry Improvement Scheme.

The data may l be circulated and discussed in confidence with those persons or organisations helping or working in partnership with Natural England to deliver the above project and initiative, in particular Defra RDPE Delivery, Environment Agency and Rural Focus.

As participation in this scheme involves expenditure of public money and there is public interest in how the money is spent, Natural England, in line with European Regulations, makes some information publicly available. Details disclosed will include, but are not limited to, your name, the name and address of your farm or business, postal town / parish, first part of the postcode, grid references, the advice you have received.

Some information may be shared with other grant distribution bodies and government departments, to enable them to detect fraudulent applications / agreements / claims and to coordinate the processing of complementary applications / agreements / claims. To do this, we may have to discuss with third parties or disclose information about funding decisions.

Natural England or its appointed agents may use the name, address and other details on your application form to contact you in connection with occasional customer research aimed at improving services that Natural England provides to you.

We will respect personal privacy, whilst complying with access to information requests to the extent necessary to enable Natural England to comply with its statutory obligations under the Environmental Information Regulations 2004 and the Freedom of Information Act 2000.

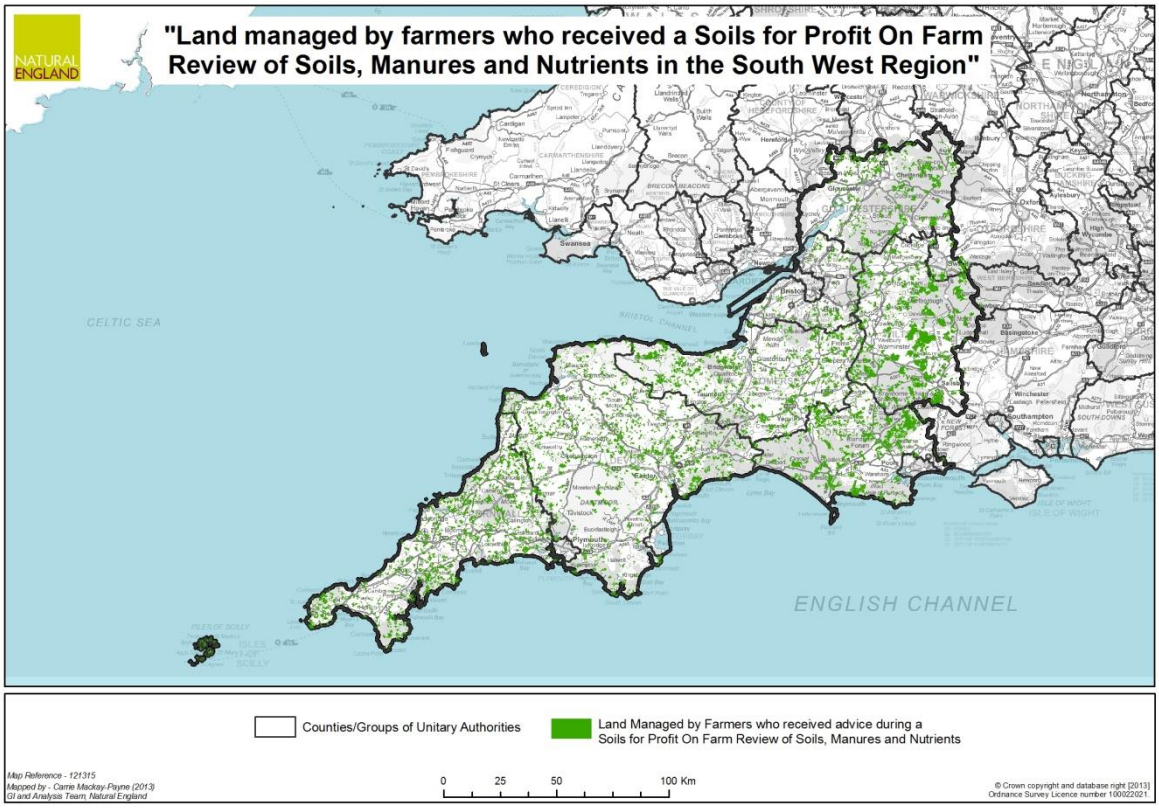
Appendix 1: Relevant Calculations

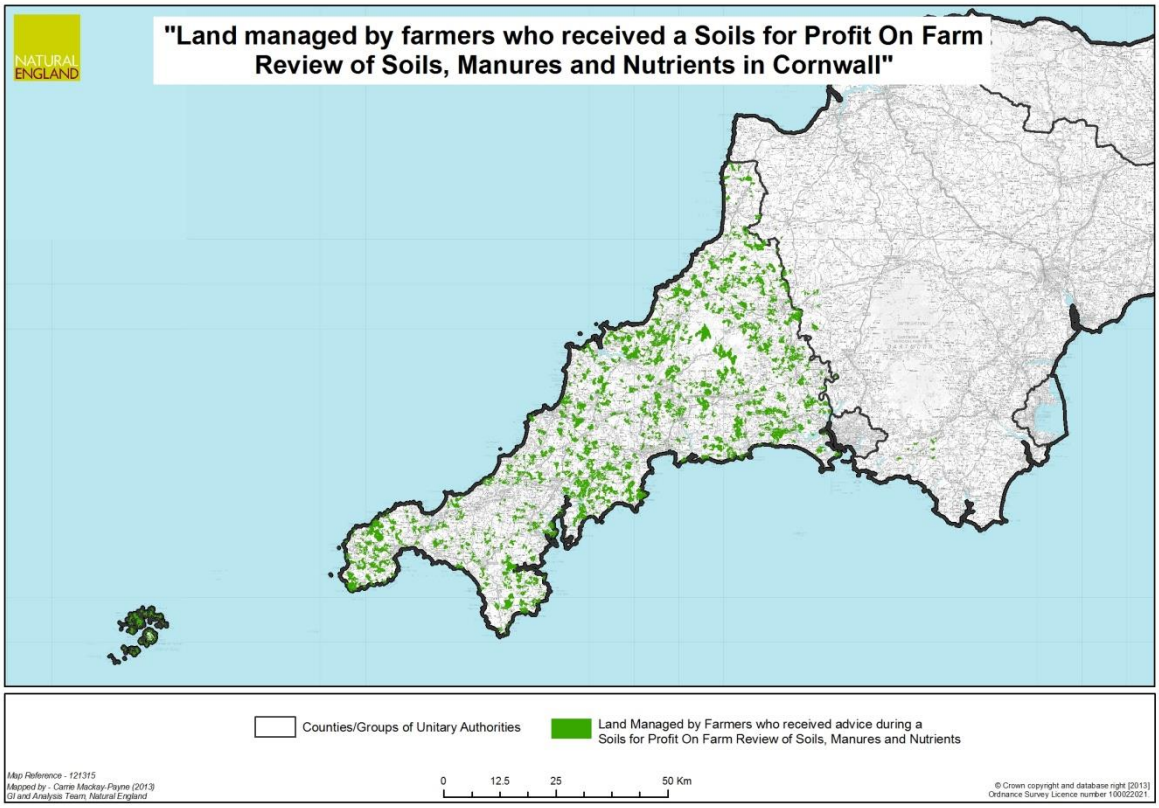
Example = Natural England spreadsheet for calculating financial value of manure and the NVZ Stocking Rate Calculation (if relevant)

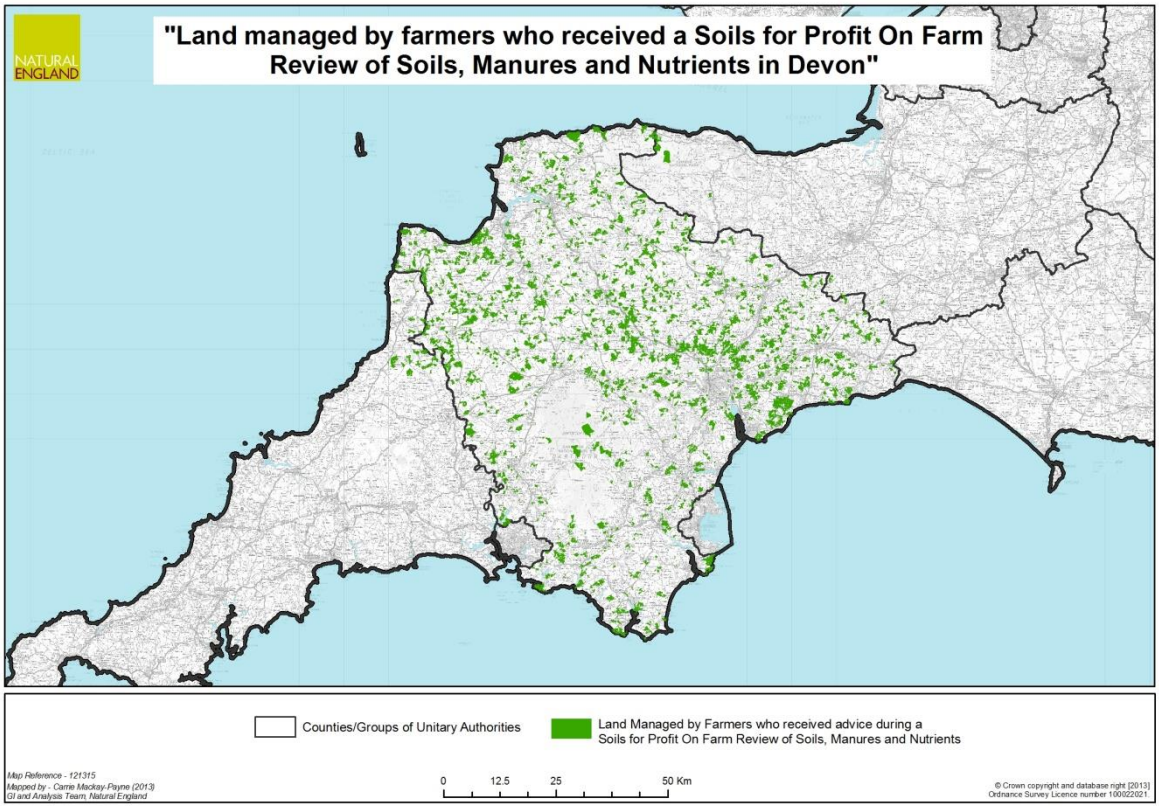
Any relevant factsheets, calculations, assumptions and programmes referred to in the main text

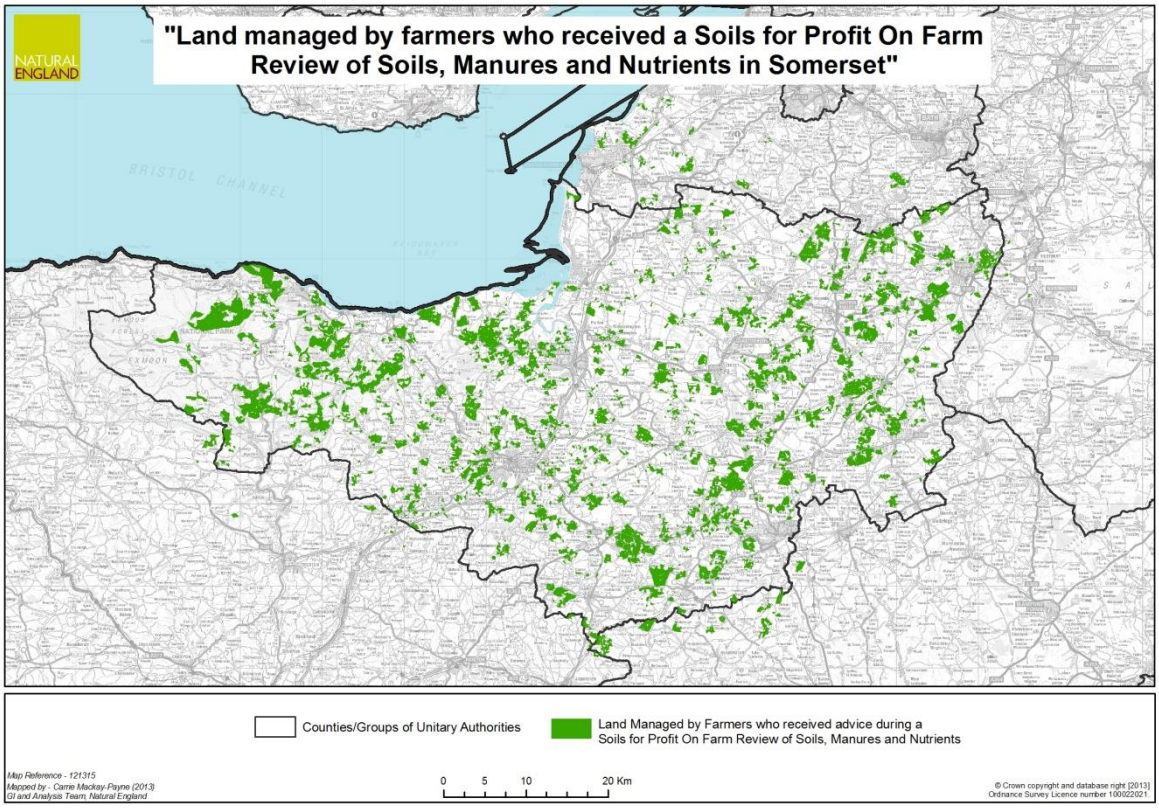
The soil sample test results for the farm paid for by the S4P Project if available otherwise they will be posted separately.

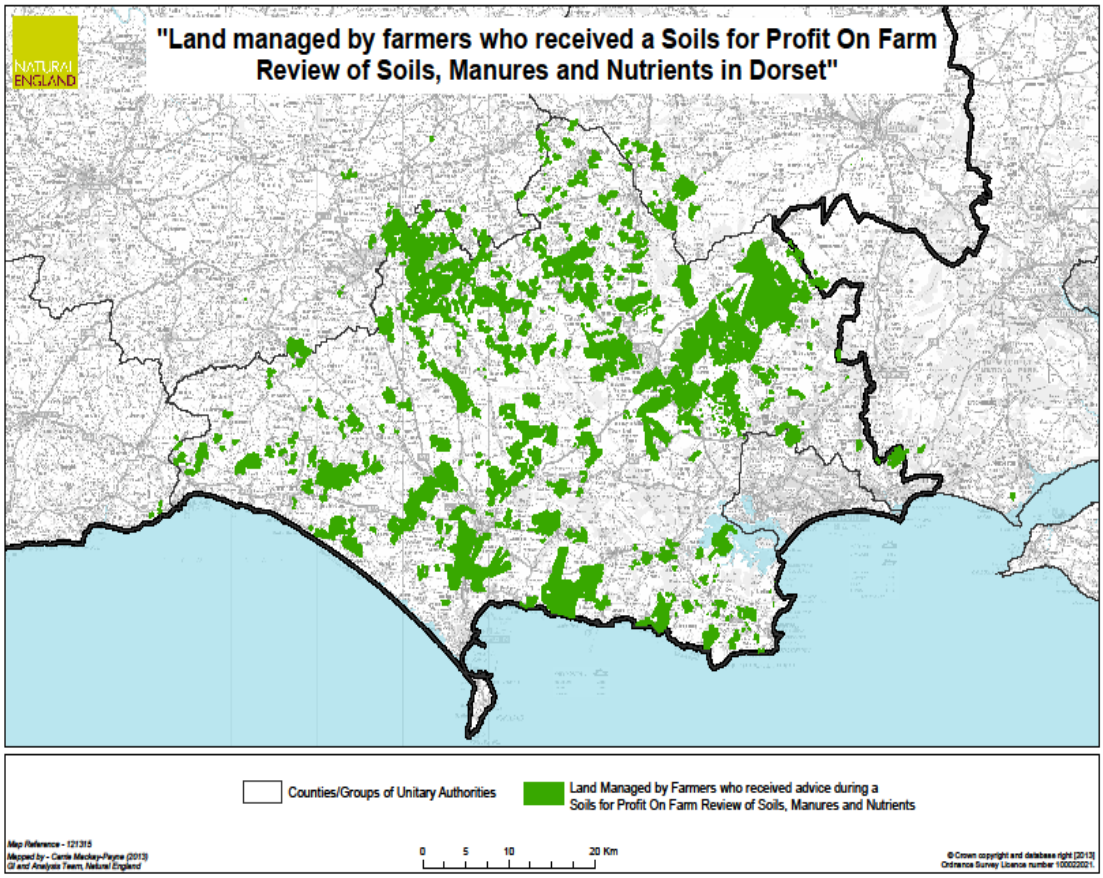
Appendix IV – Land Managed by farmers who received a S4P On Farm review of Soils, Manures & Nutrients

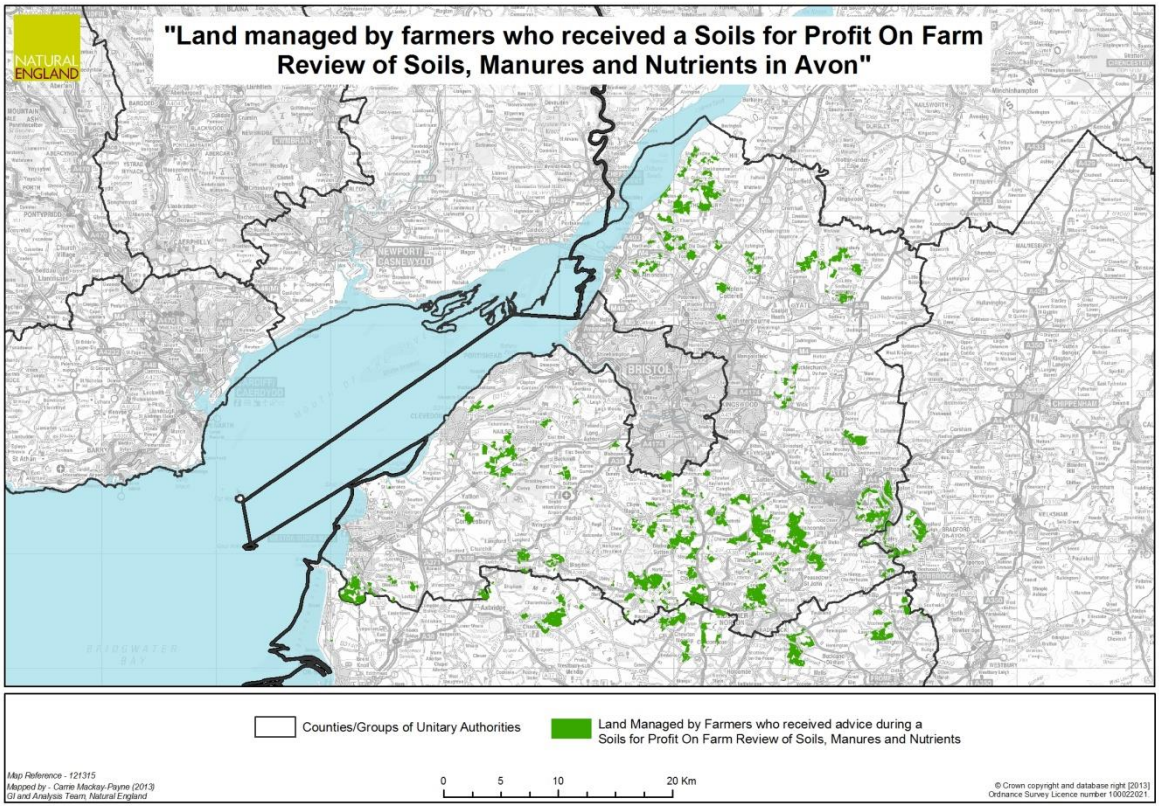


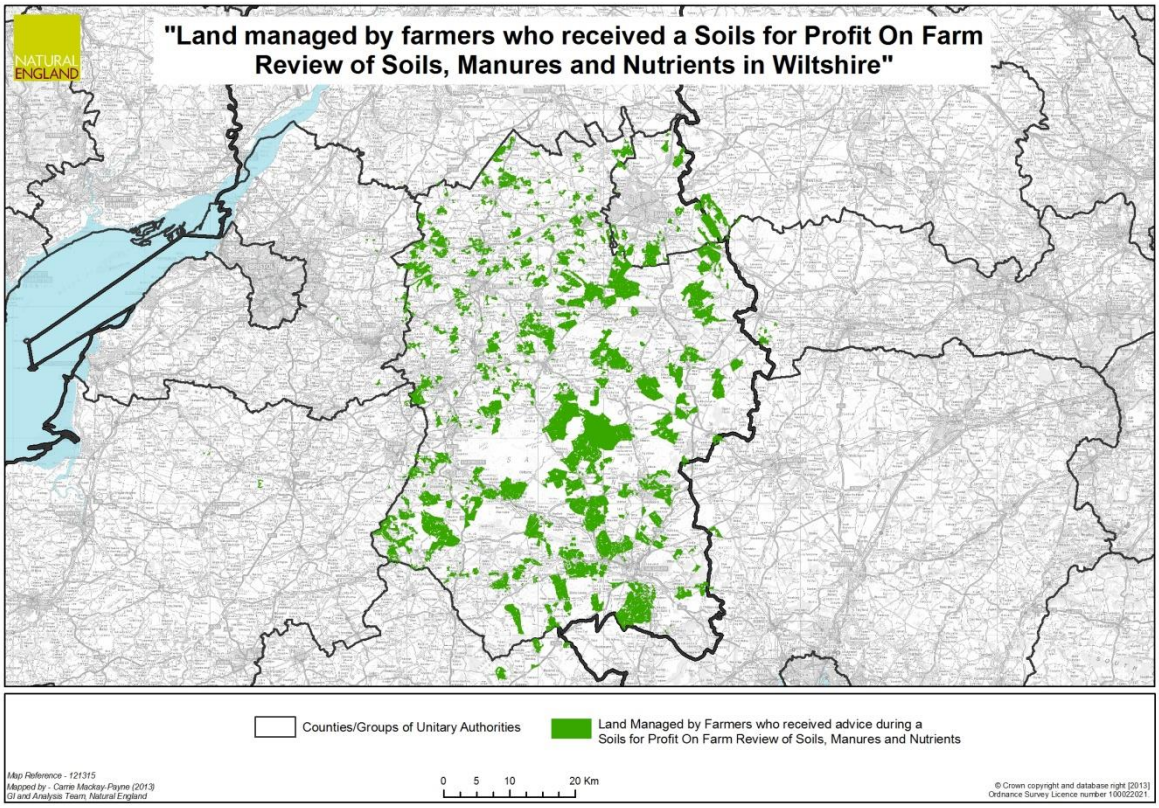

"Land managed by farmers who received a Soils for Profit On Farm Review of Soils, Manures and Nutrients in Cornwall"
NATURAL ENGLAND
Counties/Groups of Unitary Authorities
Land Managed by Farmers who received advice during a Soils for Profit On Farm Review of Soils, Manures and Nutrients
Map Reference - 121315
Mapped by - Carrie Mackay-Payne (2013)
GI and Analysis Team, Natural England
0
12.5
25
50 Km
© Crown copyright and database right [2013]
Ordnance Survey Licence number 100022021

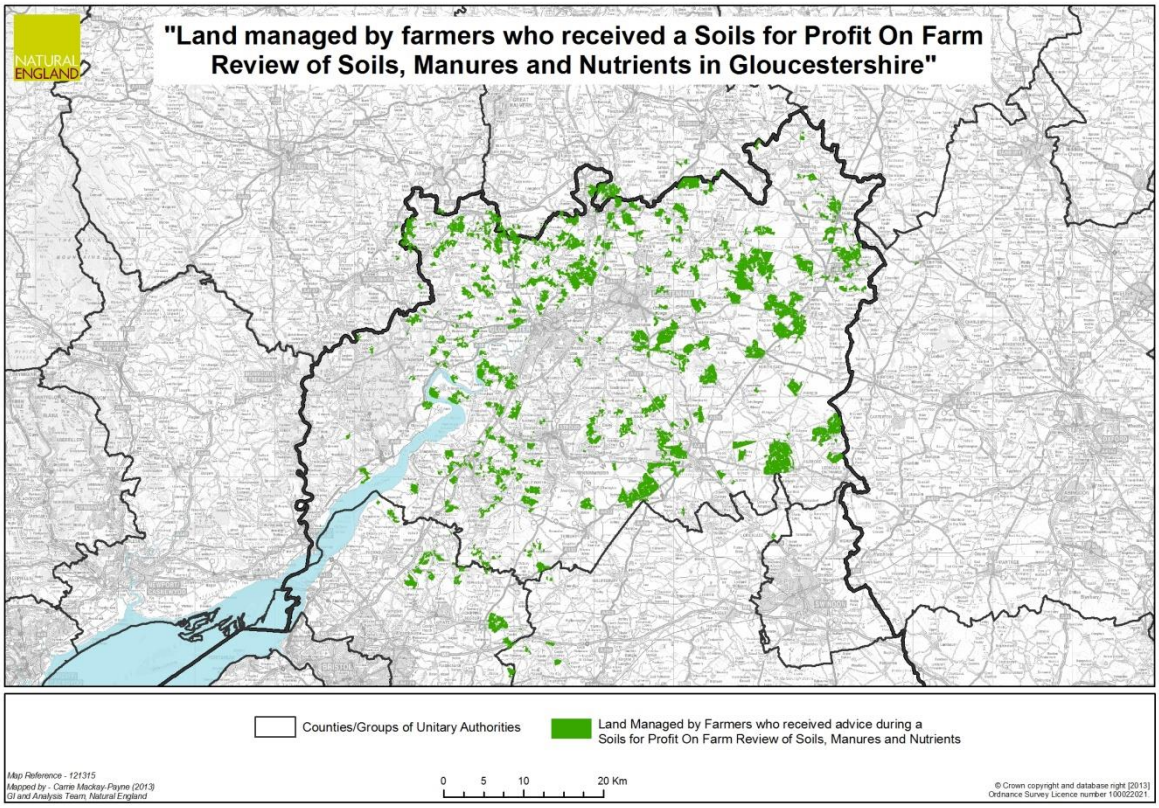

"Land managed by farmers who received a Soils for Profit On Farm Review of Soils, Manures and Nutrients in Devon"
NATURAL ENGLAND
Counties/Groups of Unitary Authorities
Land Managed by Farmers who received advice during a Soils for Profit On Farm Review of Soils, Manures and Nutrients
Map Reference - 121315
Mapped by - Carrie Mackay-Payne (2013)
GI and Analysis Team, Natural England
0
12.5
25
50 Km
© Crown copyright and database right [2013]
Ordnance Survey Licence number 100022021


"Land managed by farmers who received a Soils for Profit On Farm Review of Soils, Manures and Nutrients in Somerset"
NATURAL ENGLAND
BRISTOL CHANNEL
Counties/Groups of Unitary Authorities
Land Managed by Farmers who received advice during a Soils for Profit On Farm Review of Soils, Manures and Nutrients
Map Reference - 121315
Mapped by - Carrie Mackay-Payne (2013)
GI and Analysis Team, Natural England
0 5 10 20 Km
© Crown copyright and database right [2013]
Ordnance Survey Licence number 100022021


"Land managed by farmers who received a Soils for Profit On Farm Review of Soils, Manures and Nutrients in Dorset"
NATURAL ENGLAND
Counties/Groups of Unitary Authorities
Land Managed by Farmers who received advice during a Soils for Profit On Farm Review of Soils, Manures and Nutrients
0 5 10 20 Km


"Land managed by farmers who received a Soils for Profit On Farm Review of Soils, Manures and Nutrients in Avon"
NATURAL ENGLAND
BRISTOL
Counties/Groups of Unitary Authorities
Land Managed by Farmers who received advice during a Soils for Profit On Farm Review of Soils, Manures and Nutrients
Map Reference - 121315
Mapped by - Carrie Mackay-Payne (2013)
GI and Analysis Team, Natural England
0 5 10 20 Km
© Crown copyright and database right [2013]
Ordnance Survey Licence number 100022021


"Land managed by farmers who received a Soils for Profit On Farm Review of Soils, Manures and Nutrients in Wiltshire"
NATURAL ENGLAND
Counties/Groups of Unitary Authorities
Land Managed by Farmers who received advice during a Soils for Profit On Farm Review of Soils, Manures and Nutrients
Map Reference - 121315
Mapped by - Carrie Mackay-Payne (2013)
GI and Analysis Team, Natural England
0 5 10 20 Km
© Crown copyright and database right [2013]
Ordnance Survey Licence number 100022021


"Land managed by farmers who received a Soils for Profit On Farm Review of Soils, Manures and Nutrients in Gloucestershire"
NATURAL ENGLAND
Counties/Groups of Unitary Authorities
Land Managed by Farmers who received advice during a Soils for Profit On Farm Review of Soils, Manures and Nutrients
Map Reference - 121315
Mapped by - Carrie Mackay-Payne (2013)
GI and Analysis Team, Natural England
0 5 10 20 Km
© Crown copyright and database right [2013]
Ordnance Survey Licence number 100022021

Appendix V - Example Letter Sent Following an S4P Follow Up Visit

Direct Dial:

Email:

Day Month 2012

Dear XX

SOILS FOR PROFIT (S4P) PROJECT – FOLLOW UP ADVICE
SOUTH WEST AGRICULTURAL RESOURCE MANAGEMENT (SWARM) INITIATIVE

Thank you for reviewing your interaction with the Soils for Profit (S4P) Project during my visit on the XXth XXX 2012. I was delighted to hear that your S4P on Farm Review of Soils, Manures & Nutrients has helped you learn more about your soils and that you have taken forward a number of the recommendations made during the initial visit and contained in the written report. Please find below a summary of the main points we covered in our meeting and some further recommendations.

Since the initial S4P visit carried out by XX XX, which took place on the 26th January 2011, your farm holding and business has remained largely the same. You still focus on vegetable and daffodil production on the 9 hectares you own and other cropping still includes silage, cereals, maize and potatoes on a further 40 hectares which you rent in. You have established a new borehole which supplies your poly-tunnel produce and your two teenage sons now manage 1.2 hectares in which they grew cereals this season.

You have also installed solar panels, have experimented with straw briquettes and are interested in converting your delivery truck to run on vegetable oil. Resource Efficiency for Farmers (R4F) is a partner project that offers advice to farmers on energy, water and inorganic waste. This project includes a free consultancy day and a further 1 or 2 technical days (70% funded). You can find out more and register your interest on the Rural Focus website (http://www.businessanswers.info/rural/Resource-Efficiency-for-Farmers) or by phoning Rural Focus (Tel: 08456 047047).

The Farm and Forestry Improvement Scheme (FFIS) includes a section on Energy Efficiency and an R4F consultation may also be useful if you are considering an application for grant aid. FFIS round 2 was open in the spring / summer 2012 and has now closed. It is possible that there will be a third round in the New Year and you should keep up to date with the situation through the RDPE website (http://rdpenetwork.defra.gov.uk/funding-sources/farm-and-forestry-improvement-scheme) or by phoning RDPE Delivery Team (Tel: 0300 060 4326). This grant offers funding (usually 40%) towards the purchase of capital items aimed at helping improve the management of: -

- Nutrient management
- Energy efficiency
- Water resource management (such as rainwater harvesting including tanks and pumps)
- Animal Health & Welfare (such as mobile handling systems, upgrading crushes etc)
- Forestry

Your holding is within the 'West Cornwall Catchments' Catchment Sensitive Farming and although it is not in a Target Area it is within the Priority Area. It is just outside of the Lizard Nitrate Vulnerable Zone (NVZ), with the current boundary to the south of your holding. Due to the nature of your farm (not producing slurry and using relativity low amounts of manufactured nitrogen (N) fertiliser) you were confident about meeting the requirements of the NVZ compliance, if the boundary changes in the future. More information about the Catchment Sensitive Farming Initiative, including the capital grant funding scheme (which is open from 1st March to 30th April 2013) is available on the Natural England website (http://www.naturalengland.org.uk/ourwork/farming/csf/cgs/default.aspx). Your local Catchment Sensitive Farming Officer for the West Cornwall Catchments is Rebecca Hughes (Tel: 07775 113757).

Recommendations outlined in the initial S4P report included PLANET nutrient management software training and precision farming equipment. You have decided not to take PLANET software training to date, however should you want to look into this again there are free workshops being held in your area this winter (check the Soils for Profit Project page on the Natural England website (www.naturalengland.org.uk) or the SWARM Hub (www.swarmhub.co.uk) for dates and venues.

You are still very interested in purchasing a precision band fertiliser applicator, which would deliver fertiliser to the rows for crop use and you hope to pursue this in the near future. You have calculated that based on area coverage alone this piece of equipment could reduce your fertiliser use by two thirds. We discussed the nutrient management section of the FFIS grant funding which may be a possible source of help. You are also interested in on-farm soil testing and considering purchasing a test kit which could be in included should you choose to apply.

The initial S4P report also signposted you to Entry or Higher Level Stewardship (ELS or HLS) which you have pursued and are still interested in but are not currently in an agreement. You could possibly benefit from a free advisory visit form a Natural England approved adviser to discuss the possibility of ELS. To arrange a visit to discuss ELS please contact Natural England's ELS information and training team (Tel: 0300 060 1695), alternatively if you are happy to apply without a visit there is a hotline for application packs (Tel: 0300 060 0011). The Natural England Lead Adviser for HLS agreements in your area is Jeremy Clitherow (Tel: 07785 724821).

During the visit we talked about two cross compliance issues:-

1. The Soil Protection Review (SPR) is designed to improve soil management on farm and help prevent run-off and erosion and requires annual updates. Copies of the SPR are available to download from the cross compliance area of the Defra website (http://www.defra.gov.uk/farming-advice/cross-compliance/soil-protection/). If you are unable to produce your SPR at the time of an inspection you may incur financial penalties.

2. The new Good Agricultural and Environmental Condition (GAEC) 19 which outlines "No spread areas" whereby **you must not apply**: -

1. Manufactured nitrogen fertiliser within 2 metres of a surface water.
2. Organic manure within 10 metres of surface water or 50 metres of a spring, borehole or well.

A map of the holding must be kept showing the no spread areas (marked in red) for manures.

Soils:

You appear very aware of the soils on your holding and the need to protect them from runoff, erosion and nutrient leaching, especially where fields are steep and during periods of high rainfall. Soil on your holding is classified as Denbigh 2 type, a freely draining medium loam soil over slate / shale. You have also identified heavier strips, containing more clay in some of your fields.

You have implement a number of management techniques for soil protection including not ploughing headlands, ripping fields to break up compacted wheel tracks after harvesting and allowing buffer strips to grow in the bottom of steep fields and along hedgerows.

You indicated that you do not sub-soil due to a number of archaeological sites identified on your holding. However, soil compaction was not recognised as a problem during your initial S4P visit and based upon the small soil assessment pits we dug during my visit it appears that this is still the case.

We discussed soil management planning and the importance of regular examination of the soil through digging small soil pits to assess texture, compaction and organic matter, especially before cultivation.

You are interested in using mixed catch crops or under-sown crops to introduce a variety of root structures to help aerate your soils. You identified your agronomist, seed sellers and the internet as key sources of information to help you plan this. The fertility building pages of the Swarm Hub website may also be of interest, particularly looking at options for grassland reseeding, green manures and establishing clover (http://www.swarmhub.co.uk/sub_waste.php?id=3308). Mychorrizal fungal inoculants can also help hold soils together, bring nutrients up to crop roots and introduce air throughout the profile.

Despite the wet weather this year you have seen little sign of poaching where cattle have been out on some of your rented fields, even around the feeders. This is a sign of good underlying soil condition and added protection from good grass leys. Effects of trafficking and poaching on soils include:-

- Impeded drainage
- Reduced aeration
- Anaerobic layers
- Hard pans
- Reduced incorporation of organic matter

In your vegetable and bulb fields you use a 78 inch bed system, cultivated across the contours which prevents the beds slipping down-slope and is easiest to maintain. The initial S4P report identified that allowing grass to grow on older and fallow beds was helping to stabilise the soil structure and prevent run-off. In the wet weather this year you have also noticed that grass cover has shielded the soil from the effects of heavy rainfall and has helped direct water into the buffer strips at the edges of your fields where it is absorbed by the vegetation.

Nutrients:

In 2010 the annual fertiliser use was 3 tonnes. You indicated that although the nutrient strategy has remained the same there has been a small reduction in fertiliser used this year due to cropping. You estimated that this year's fertilizer application is about XX tonnes.

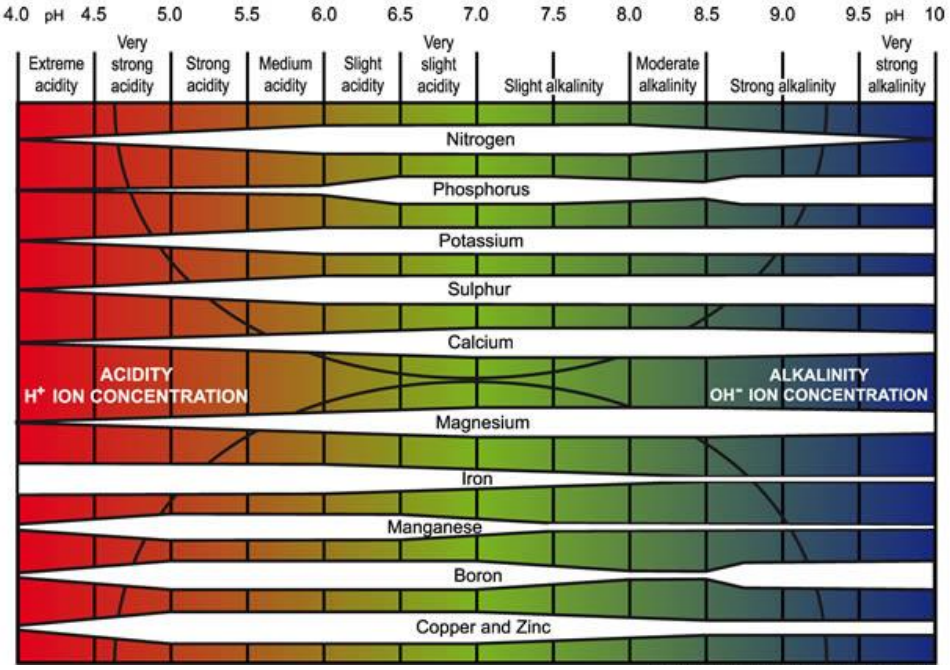
You test soil nutrients in cropped fields every 2 to 3 years and test pH across your holding more regularly. Your pH analysis indicates no need for liming with values in the range 6.5 to 7 which you suspect is due to historical use of sea sand with a long-lived liming value.

The initial S4P report identified that although overall amounts of fertiliser use are low, the rate of application per area is high. The recommendation to regularly test P, K & Mg is still applicable in order to monitor the base level characteristics of the fields and ensure that the right amounts of fertiliser are applied. You are interested in on farm testing and considering purchasing a kit. There are also a number of independent labs that offer soil testing, some of which can be found listed on the nutrient planning website (http://www.nutrientmanagement.org/Support-and-advice/Soils/Soil-testing---find-a-laboratory/).

Soil Nitrogen Supply (SNS) is calculated from a number of factors including mineral N (or, more commonly, an estimate of this based on rainfall, soil type and previous cropping), N content of the previous crop and estimated Mineralisable (available) soil N as ammonium or nitrate. There is a useful SNS calculator available from Tried and Tested which can be found on the nutrient management website (http://www.nutrientmanagement.org/Tools/Soil-Nitrogen-Supply-Calculator/).

You currently apply fertiliser by broadcast and pursuing the purchase of a precision band fertiliser applicator will help reduce the quantity you use, saving you money and reducing the risk of diffuse pollution by run-off. You can also find information about the nutrient requirements of different crops in the RB209 fertiliser manual, available through the Defra website (http://www.defra.gov.uk/publications/files/rb209-fertiliser-manual-110412.pdf).

During our conversation we looked at the diagram below, indicating the availability of nutrients at different soil pH conditions and you expressed an interest in finding out more about this topic. In soil conditions near neutral (pH 7), the microbial conversion of ammonium to nitrate is rapid, and crops generally take up nitrate. In acid soils (below pH 6) this process is much slower.



It is also important to remember that poor soil conditions e.g. water-logging and compaction will greatly reduce the efficiency of nutrient availability to the crop.

Diagram sourced from www.pda.org.uk, redrawn by PDA from Troug 1946.

You also expressed an interest in Nutrient Demo days and S4P Farming More Precisely Case Study events. During the Autumn / Winter 2012/13 the Soils for Profit Project is holding workshops and events across the South West, including: PLANET (computer based nutrient planning and recording system) training, NVZ compliance workshops and Farming More Precisely “case study” events. Dates and venues will be published on the Soils for Profit Project pages of Natural England’s website (www.naturalengland.org.uk) and on the Swarm Hub website (www.swarmhub.co.uk). To book places you can call Tel: 01823 445 030 for the NVZ and Farming More Precisely Case Study events or call Tel: 01270 616800 for the PLANET workshops.

Manures:

The only livestock on the holding are 10 pigs which produce a limited quantity of farm yard manure (FYM). You still import slurry and manure from neighbours when available and try to time its application to when crops will use the nutrients for growth, bearing in mind weather conditions. You keep records of manure applications in your diary and during my visit we looked at the Tried and Tested manure and nutrient planning and record sheets which are available to download from the nutrient management website (http://www.nutrientmanagement.org/The-Plan/The-Plan/).

You have recently looked into precision slurry application equipment and attended an open day where a shallow injector was demonstrated. However you have concerns over the suitability of this machinery on smaller, steeper fields characteristic of your holding.

You may find that the S4P Farming More Precisely farmer case study events referred to above will provide further information. Invites for these will usually be posted to farmers in a radius around the chosen venue. Please see above for information about dates, venues and bookings.

Other ways of minimising N losses include rapid incorporation, spreading during the spring when plants are growing and avoiding both high rainfall and overly warm conditions. Planting a cover crop between harvests and sowing the next crop is also highly effective at retaining N over the winter. The cover crop will provide re-mineralised N to the soil when it is killed off, with early drilled crops making the best use of available N.

The initial S4P report recommended targeting manure application on silage and arable fields based on crop nutrient needs and manure nutrient content. Eurofins laboratory have developed a new rapid NIRS test for nutrient analysis of manures, bio solids and slurries (http://www.eurofins.co.uk/agriculture-testing/manure-testing.aspx).

Thank you once again for your time your feedback has been very useful and it was a pleasure to meet you.

If you have any queries regarding the contents of this summary or any further questions which you feel S4P may be able to help with, please contact me on Tel: XXX XXX or the main S4P number Tel: 0300 060 1244.

Yours Sincerely

Environment Agency

Solutions for Business
Funded by government

defra
Department for Environment Food and Rural Affairs

European Agricultural Fund for Rural Development:
Europe Investing in Rural Areas

Appendix VI - Most Common Recommendations and Take Up by County

Figure S1: Most Common 12 Recommendations & Take Up by County

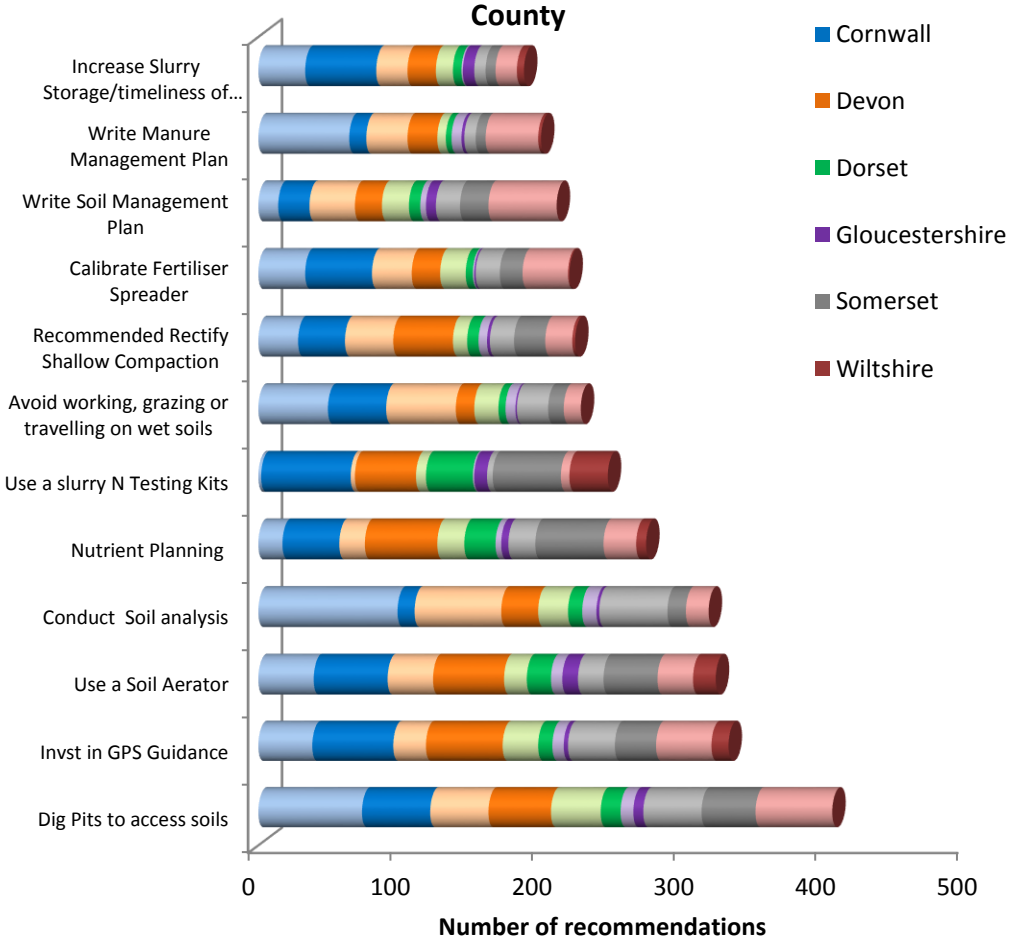


Figure S2: Middle 12 Recommendations & Take Up by County

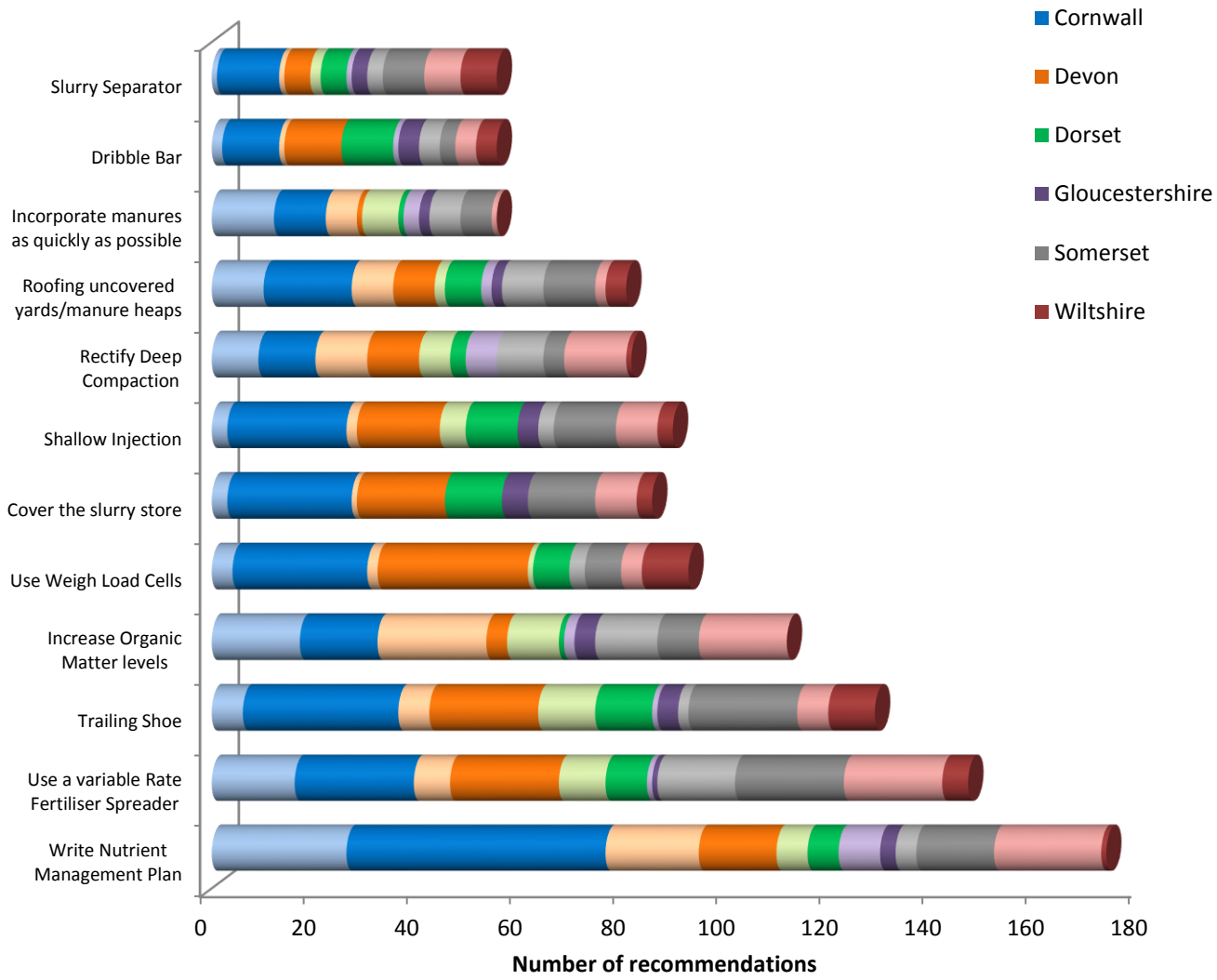
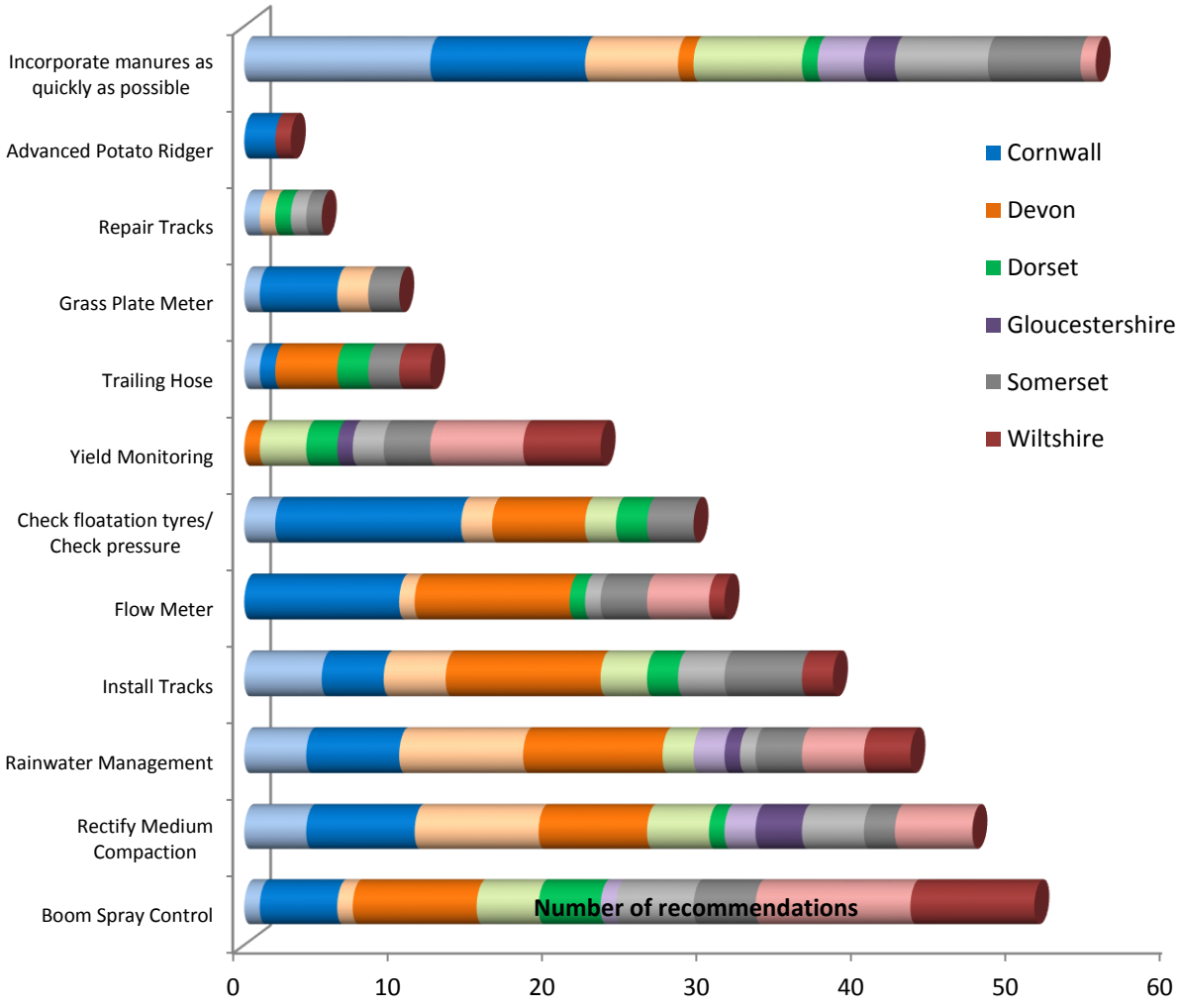


Figure S3: Bottom 11 Recommendations & Take Up by County



APPENDIX VII - Written comments from farmers who received S4P On Farm Reviews of Soils, Manures and Nutrients

- "I was very pleased with the visit, and gained and refreshed my knowledge of soil management, and as far as we can afford, will put the recommendations into practice."
- "Very helpful. We have sent parts of the report to the Cornwall Farmers' agronomist for help with fertiliser recommendations/purchase of fertiliser. (Hope in the future our local group might work with S4P to bulk buy?) Thanks – lovely to have someone to walk the fields/advise."
- "The adviser I had here was first class and had an answer for every question I posed. Absolutely superb service. Thank you."
- "Soils are the farmer's basic asset. Some farmers do not realise this. It is very important to protect our soils and treat them correctly. Thank you for your enlightening visit. I hope the grant scheme starts again soon, then you can publicise S4P workshops etc."
- "All very good and excellent. Would be good to know if the funding will be available in the near future."
- "Very good. I think more farmers should take time to think about the quality and fertility of their soils, especially larger livestock farms carrying large headage on wetter land, causing compaction."
- "I found Matt Kingdon to be very knowledgeable and he offered very good practical advice on all aspects of soil management. I plan to do a lot more digging in the future!"
- "It really makes a difference to have a one-to-one on-farm visit".
- "Very happy with the outcome of the visit – Matthew very knowledgeable and explained issues in a clear and concise way."
- "A very much one-to-one approach which is very worthwhile to the farmer – much easier to understand and to ask questions. Thank you!"
- "Superb service – brought details to forefront which had been slightly neglected, i.e. soil sampling grass grounds – hopefully will encourage better management."
- "Thank you for your effort to improve farmers' understanding of NVZs and nutrient management. Also thank you for the free soil samples."
- "On-going help is required to help fulfil NVZ obligations, and to keep up to date with requirements. There are too many regulations and too much online information to keep up with without assistance. Many thanks for the comprehensive and useful report."
- "Excellent down to earth approach from people who understand farming and farmers. What a breath of fresh air."
- "Very interesting and very helpful. Thank you."
- "The S4P review does stand-alone but would be of more use with follow-up reviews. It is only too easy to file a one-off review. In this case we have found the advice extremely helpful and are already acting on the report contents."
- "Ongoing advice/support required to follow on from today's visit."

Appendix VIII

A report summarising the findings from soil samples collected by farmers in the South West and analysed through the Soils for Profit Project

Introduction

The South West Agricultural Resource Management (SWARM) Initiative is a Rural Development Programme for England (RDPE) funded initiative tasked with helping farmers and growers to use resources more efficiently, providing both economic and environmental benefits.

The Soils for Profit (S4P) project, delivered by Natural England in partnership with the Environment Agency and as part of the SWARM Initiative, has operated a scheme since 2011 giving farmers the opportunity to collect soil samples from up to five fields of their choice and to have the samples analysed free of charge to the farmer. The results from the soil analysis were then used by the S4P farm advisers to support advice specific to the farm as part of the S4P 'On-Farm Resource Review of Soils, Manures and Nutrients', and in particular, to help demonstrate nutrient budgeting.

The SWARM Hub, also part of the SWARM Initiative, has collated and analysed the data from 3,447 samples to produce this report in association with S4P staff.

The aim of this report is to summarise the findings of the samples taken in terms of:

- Soil pH;
- Soil Organic Matter (SOM) status; and
- Key nutrients *i.e.,* Phosphate (P), Potash (K) and Magnesium (Mg).

Methodology

Upon registration to the Soils for Profit project farmers were sent packs with instructions on how to take the samples. The soil samples were then collected and sent to the appointed laboratory by the farmers themselves. Standardised analysis was carried out by NRM (Natural Resource Management Ltd.) and the results for each farmer returned to the S4P Project which assigned them to a farm adviser who interpreted the results and demonstrated nutrient budgeting for the farmer whilst on farm. The results obtained between September 2011 and August 2013 were aggregated and supplied by the Natural England's S4P project team (anonymised) to the SWARM Hub for this report.

Results from a total of 3,447 soil samples (usually from different fields) were included in the dataset, from 699 participating farmers, spread across the six counties of the South West Region. Figure S1 in the appendix shows the spread of samples and farms by county.

Each sample was analysed for pH, SOM, and key nutrients P, K and Mg. Farmers were also asked to specify the current cropping. For the purpose of this report the crop types have been grouped into arable (including cereals, vegetables and bulbs) and grassland (including permanent pasture, short-term leys and silage crops).

When reading this report it should be remembered that soil samples are often taken by farmers from their more challenging fields. If this was the case it could influence the data. However there is no indication that this happened, therefore for the purpose of this analysis, it is assumed that the samples were taken across a representative area of the farms by those farmers who participated.

Results and conclusions

Of the samples analysed 771 soil samples were from arable land, whilst 2,578 soil samples were from grassland and 98 soil samples did not specify the cropping. The latter were not included in this preliminary analysis.

The number of soil samples that were either under, met or above the recommended pH, SOM and key nutrient targets, as set out in Defra publication RB209, are shown in Table S1.

The number of soil samples that were under the recommended pH, SOM and key nutrient targets, as set out in Defra publication RB209, are shown in Table S2 and S3 in the appendix.

Soil pH

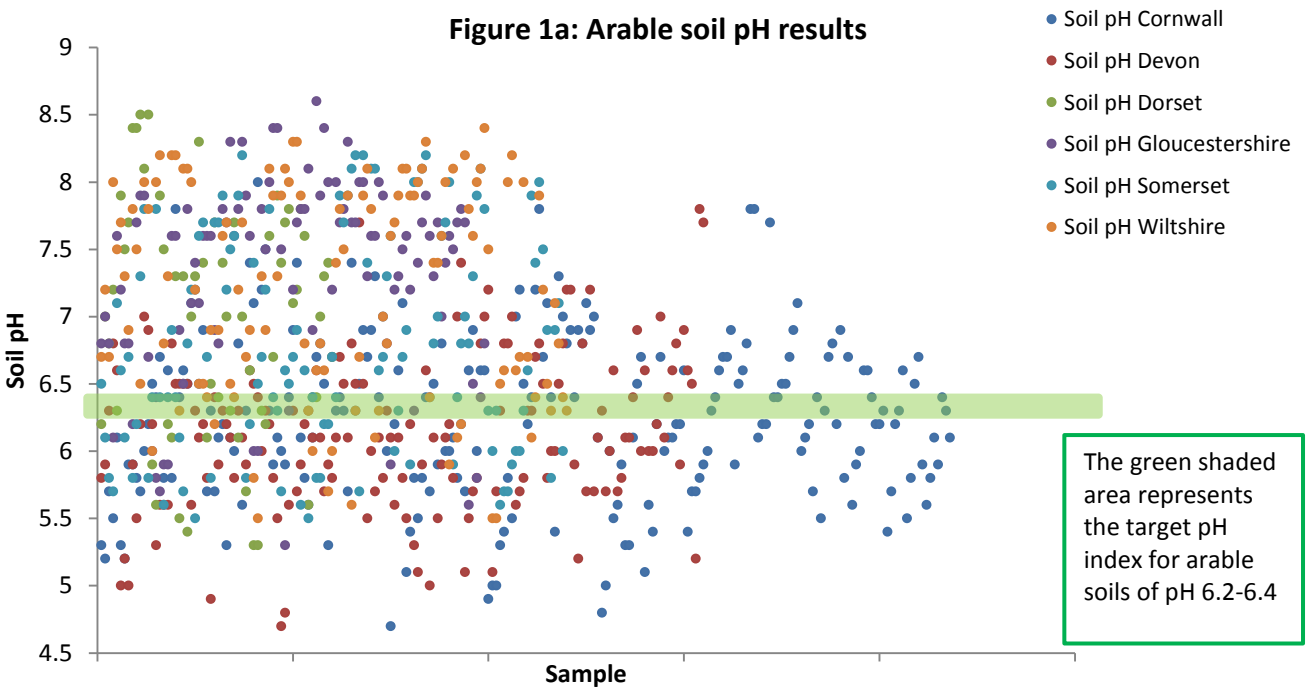
The pH is a measure of acidity or alkalinity, with agricultural soils typically ranging from a pH of around 4.5 (termed ‘very acid’) to around 8.5 (termed ‘alkaline’). The availability of plant nutrients will vary depending on the soil pH and the optimum availability will occur over a small range of pH values, termed the target pH range. The table below specifies the target pH range for both arable and grass cropping.

Cropping	Target pH Range
Arable	6.2 - 6.4
Grass	6.0 - 6.2

Source: RB209 Fertiliser Manual, Defra 2010

Of the 3347 soil samples tested for pH, only 14.3 % (110) of all the arable field samples and 16.8% (432) grassland samples were within the target pH range (Figure 1a and 1b).

Fields under the target pH comprised 47% taken across all samples. This included 31.8% (245) of the arable samples and 51.6% (1,329) grassland samples.



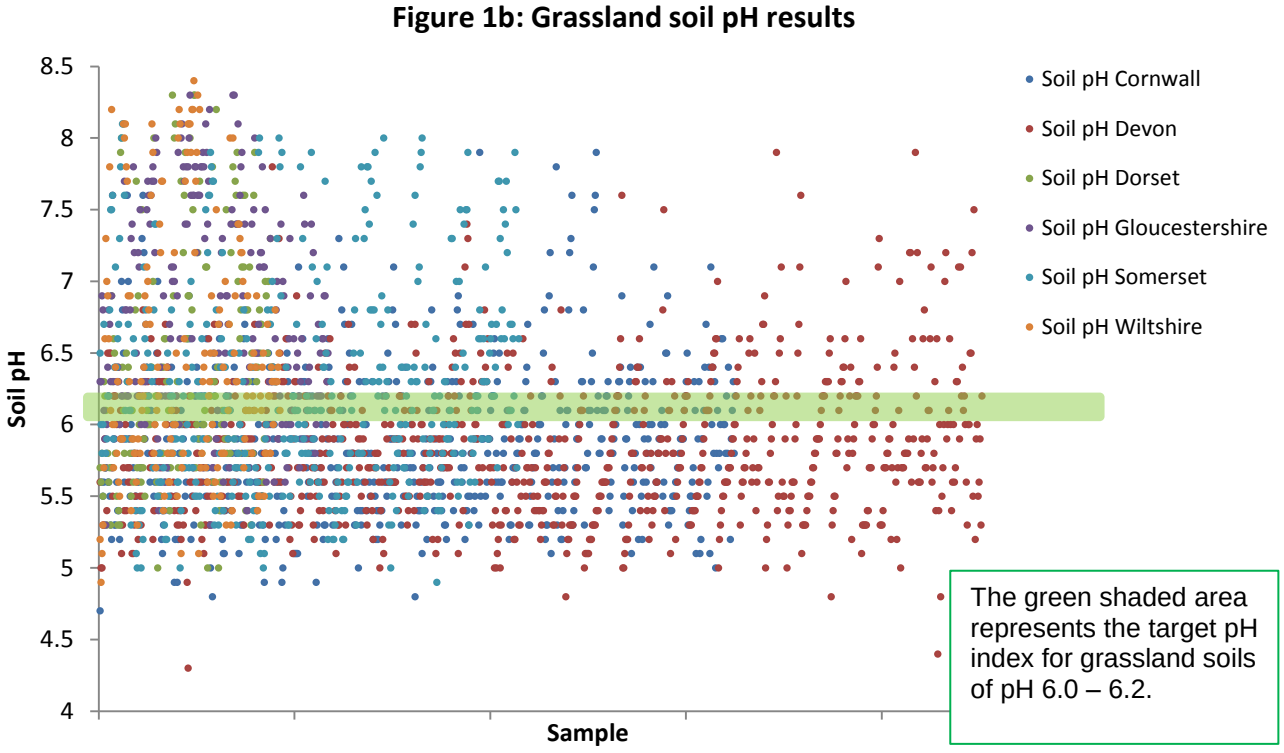


Figure 1: Each arable (a) and grassland (b) sample has been plotted against its pH level. Each dot represents an individual soil sample. The dots are colour-coded according to county. Those that lie within the green shaded area are within the target pH range. Those that fall outside the green shaded area are not within the target pH range. See Figure S3 and Table S1 in the appendix to see the percentages of samples that fall outside of the target pH range as set out in the Defra RB209 Fertiliser Manual.

Just under one third of all grassland soil samples taken in the South West fell within the pH range of 5.5 – 5.9 (See Figure S2 in the appendix). Soils with pH lower than the recommended values will have significantly reduced nutrient availability to the crop, especially in the case of phosphate. Micro nutrients are also significantly affected by pH and decisions to apply additional nutrients should only be made after underlying pH issues are remedied. Although it is important to remember that some plants and habitats favour acid conditions, these are unique cases. To learn more about the benefits of optimal soil pH and tips on how to accomplish a good soil pH click here.

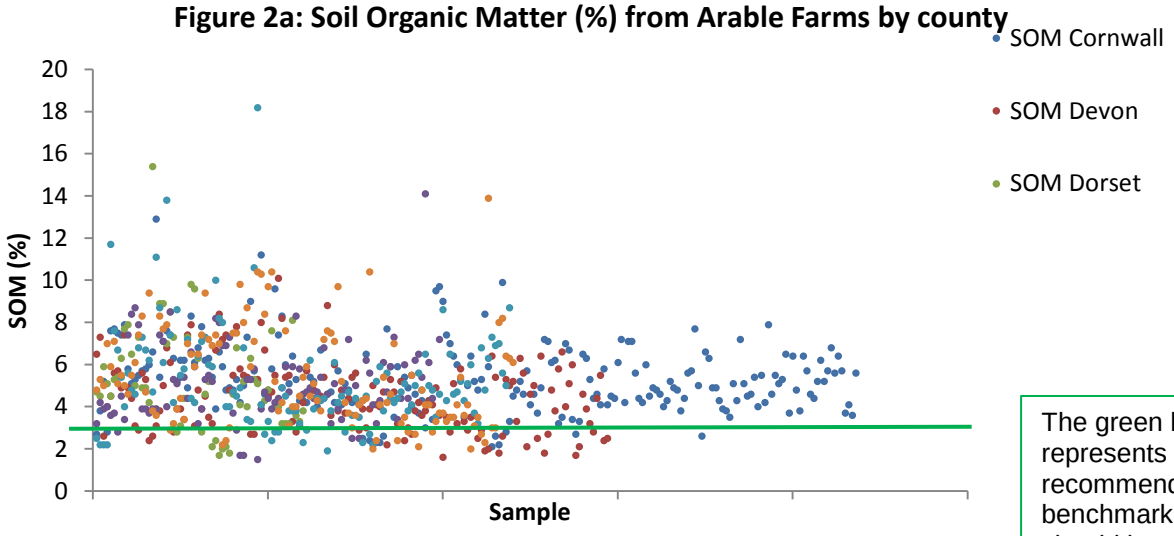
Soil Organic Matter (SOM)

SOM helps bind soil mineral particles together and is important for providing crops with a number of essential nutrients in available forms. Maintaining a good SOM is important as it is essential for chemical interactions within the soil and also helps to strengthen soil structure. SOM is expressed in this report as a percentage of soil volume.

There are no specific targets for SOM, as the amount of organic matter in a soil is highly dependent on factors such as soil type, climate and farming system. However, the general recommendation is to at least maintain, and where possible increase SOM levels. An organic matter of below 3% is recognised by many advisers as being a catalyst for long-term soil problems.

Figures 2a and 2b show that SOM is much lower in arable fields than grassland as more than 11.3% of arable soil samples were below the 3% SOM benchmark as opposed to only 1.5% of grassland soil samples. National findings indicate that declining SOM is a growing problem particularly in arable situations If you would like to read more about enhancing your soil biology click here.

Figure 2a: Soil Organic Matter (%) from Arable Farms by county



The green line represents the recommended benchmark that soil should be made up of at least 3% SOM

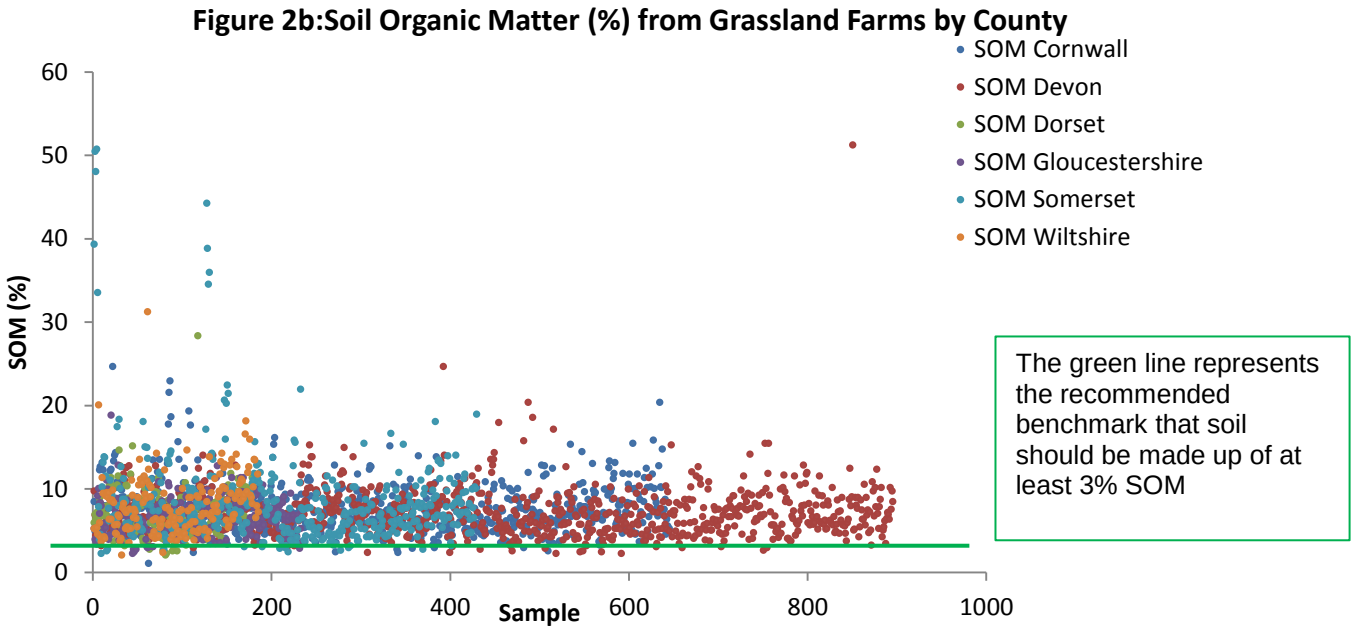


Figure 2: Each arable (a) and grassland (b) sample has been plotted against soil organic matter percentage volume. Each dot represents an individual soil sample. The dots are colour-coded according to county. Those that lie on or below the line are thought to be at risk of long-term problems and those that lie above the green line are above the recommended 3% benchmark.

Key Nutrients

Phosphate (P), Potash (K) and Magnesium (Mg) indices were analysed in all soil samples. The target indices for all crops are as follows:

Nutrient	Target Indices
Phosphate	2
Potash	2-
Magnesium	2

Source: RB209 Fertiliser Manual, Defra 2010

and K levels over or under the target index will impact on crop productivity as well as how the crop utilises other applied nutrients. If the index is too high there is a risk of economic and environmental loss through applying nutrients that are not required, and if the indices are too low there is likely to be yield consequences.

Being over the target index for Mg typically will not limit crop production and grass growth is unlikely to respond to applications; nevertheless, it is important to maintain levels in order to prevent Mg deficiency in cattle which causes the metabolic disorder known as grass staggers. This analysis revealed only a small percentage of samples that were under the target index for Mg, the majority were within or above it.

This analysis revealed that 29.2% (225) arable samples and 44.8% (1,156) of grassland samples which were taken from farms across the South West region were under target for Phosphate (P) index (see figures 3a and 3b). These percentages did not vary much between counties.

When testing for Potash (K) values, the analysis revealed that 23.2% (179) of the arable samples and 43.5% (1,121) grassland samples were not meeting the target index (see figures 4a and 4b). Cornwall showed the highest proportion of arable (44.7%) soil samples below the target index for K and Devon had the highest proportion of grassland soil samples (16.6%) below the target index for K.

It should be noted that for both key nutrients i.e. Phosphate & Potash the grassland samples showed lower levels than did the arable samples.

In terms of Magnesium (Mg) this was the contrary, a higher percentage of arable samples (5.9%) were below the target index whereas the grassland samples only 1.5% were below target (see figures 5a and 5b).

Figure 3a: Arable farms - P indices by county

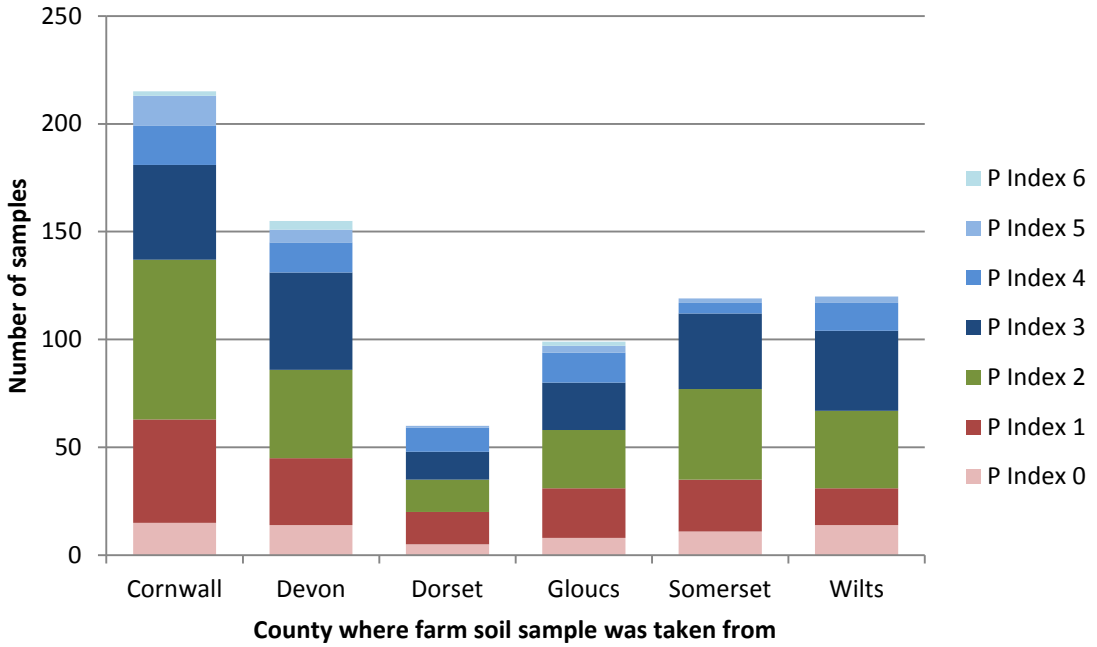


Figure 3b: Grassland farms - P Indices by county

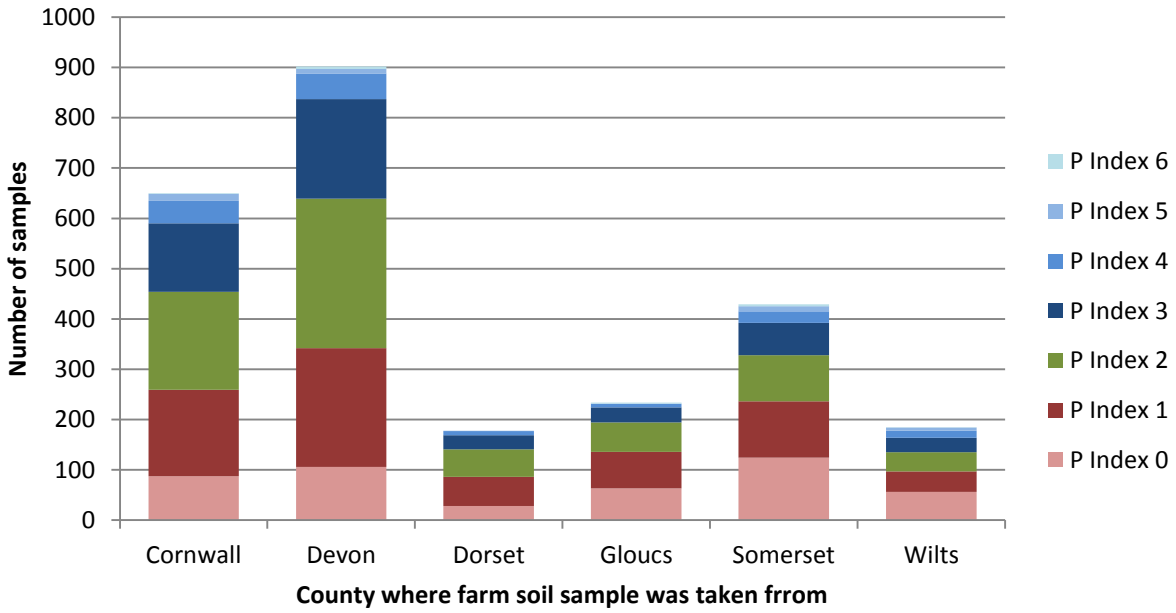
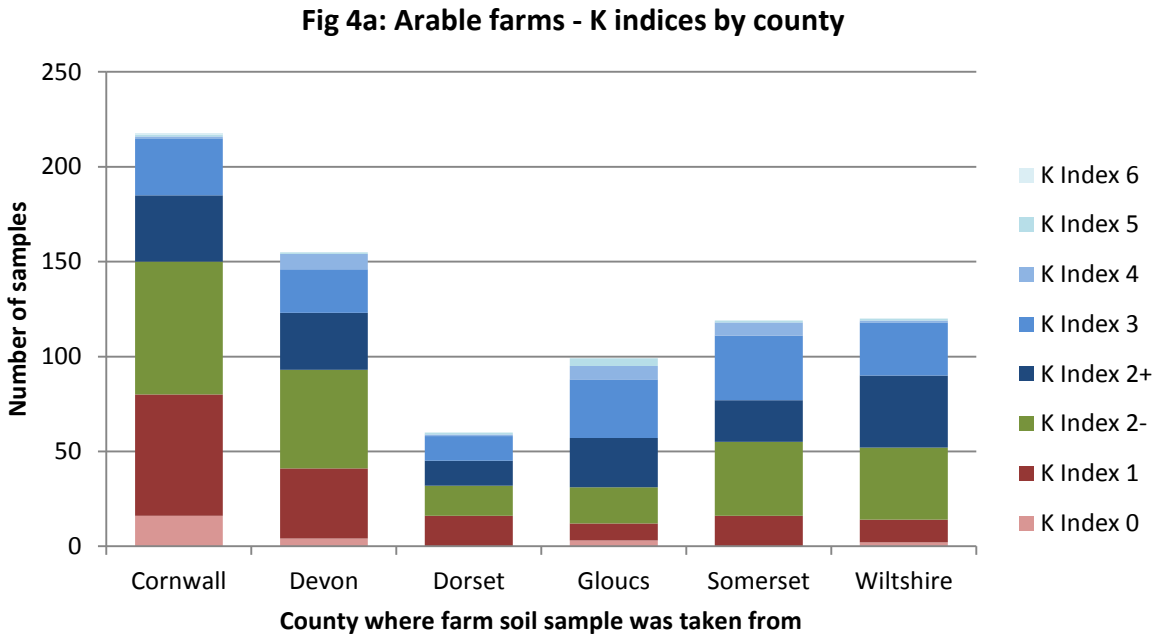


Figure 3: The graphs shows the number of arable (a) and grassland (b) farms soil samples that scored each of the P index values categorised by county. The index scales ranges from 0 – 6 and the target index for P is 2. The area of the bar that is red or pink represents the samples which were under the target index, the areas which are green met the target index, and the areas which are blue exceed the target index.



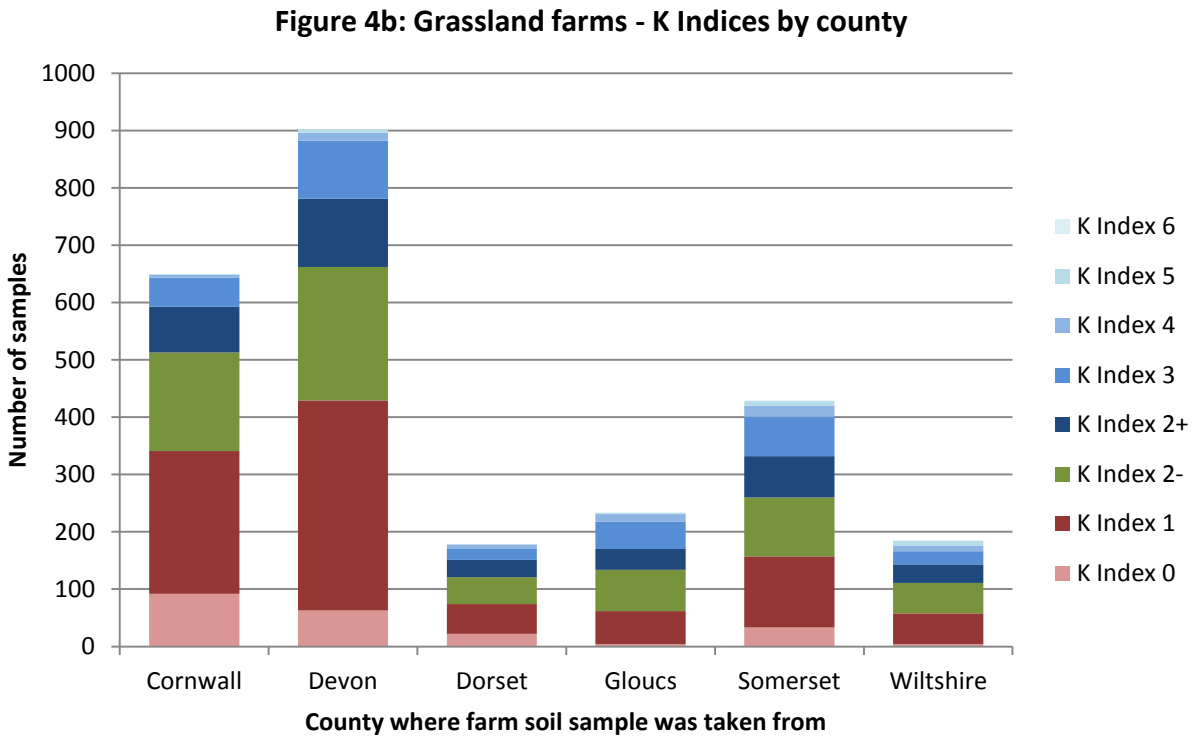
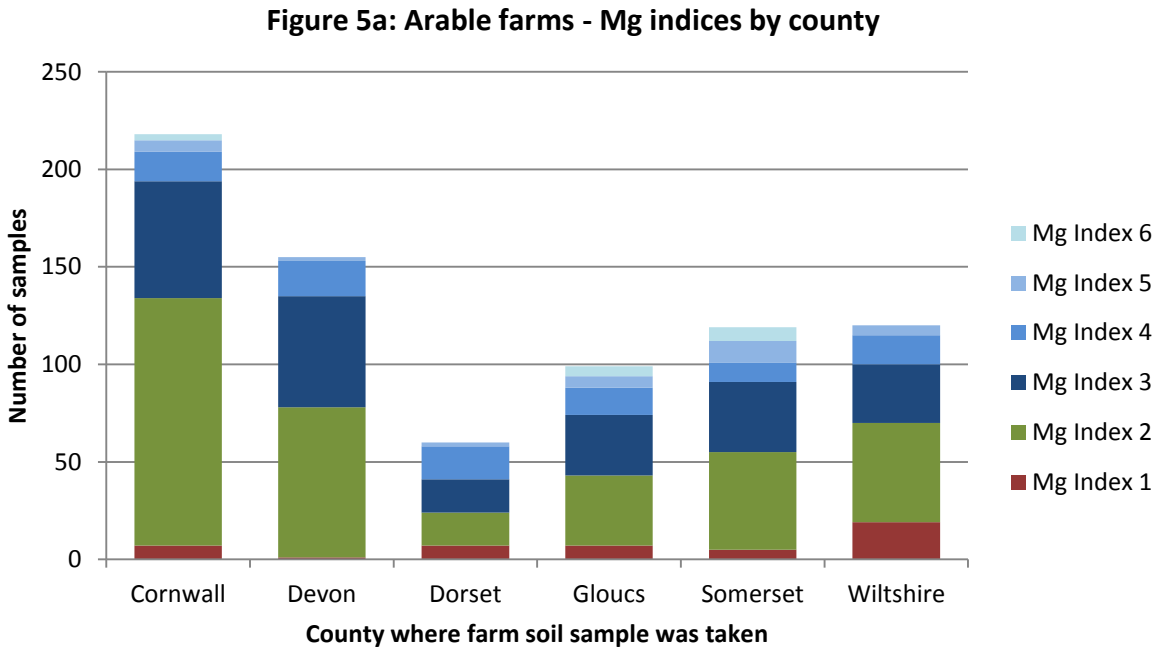


Figure 4: The graphs shows the number of arable (a) and grassland (b) farms soil samples that scored each of the K index values categorised by county. The index scale is 0, 1, 2-, 2+, 3, 4, 5, and 6, and the target index for K is 2-. The area of the bar that is red or pink represents the samples which were under the target index, the areas which are green met the target index, and the areas which are blue exceed the target index.



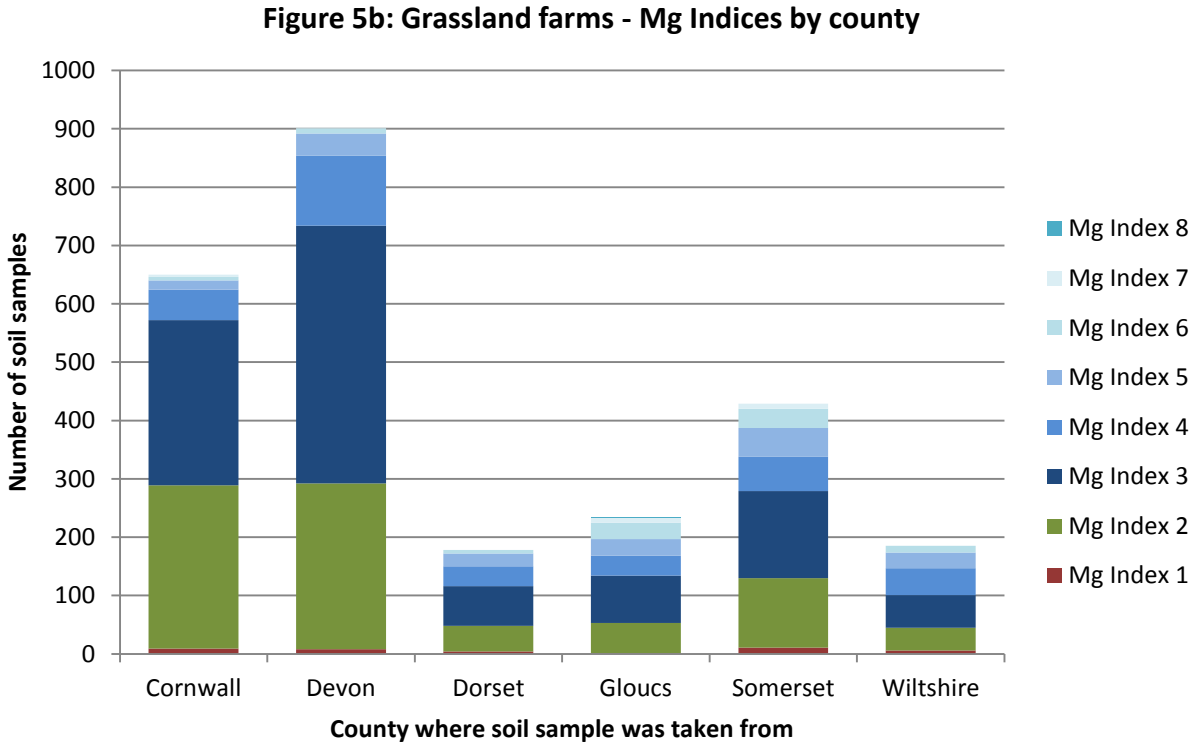


Figure 5: The graphs shows the number of arable (a) and grassland (b) farms soil samples that scored each of the Mg index values categorised by county. The index scale ranges from 1 – 8 and the target index for Mg is 2. The area of the bar that is red represents the samples which were under the target index, the areas which are green met the target index, and the areas which are blue exceed the target index.

In summary the findings suggest that:

- Approximately one third of all samples met the target index for P, K or Mg
- Samples below the target index were as follows:-
    - 41.2% - P ,
    - 38.8% - K,
    - 2.5% - Mg
- Samples on target were as follows:-
    - 29% - P
    - 27.3% - K
    - 35.1% - Mg
- Soil samples above target were as follows:_
    - 29.7% - P
    - 33.9% - K
    - 62.3% - Mg
- Cornwall has the highest proportion of soil samples from arable fields (>40%) below the target index for K
- Overall a much higher proportion of grassland soil samples are below the target index for P and K than arable soils
- Only a small number of both arable and grassland samples are below the target index for Mg

Key Conclusions

Soil pH

- 47% of samples taken were below the target pH as specified in the Defra RB209 fertiliser manual
- Devon has the highest proportion of arable (53.5%) and grassland (64%) soil samples below target pH
- Cornwall had the second highest proportion of arable (44%) and grassland (63%) soil samples that were below target pH
- Gloucestershire has a high proportion (83.8%) of arable soil samples that were above the target pH
- Dorset and Wiltshire had a high percentage of samples (both arable and grassland) which were above the target pH

Soil Organic Status

- From the soil samples taken from arable farms in Gloucestershire only seven were below the 3% benchmark
- Only two grassland samples from farms in Wiltshire, five from Gloucestershire and six from Dorset were below the 3% SOM benchmark

The analysis showed that 22.6% of samples from arable fields and 3% from grasslands had an organic matter percentage below the 3% benchmark ***Key Nutrients***

- In four of the six counties approximately 50% of grassland soils sampled were below the target P index (Dorset, Gl***o***ucestershire, Somerset and Wiltshire). In Cornwall and Devon approximately 38% of grassland samples were below
- Arable farms in Cornwall were particularly K depleted compared with the other counties in this study
- Between 30 – 55% of grassland soil samples taken from Cornwall, Devon, Dorset, Somerset and Wiltshire were below the target K index
- More arable samples had P and K indices which were above target than grass samples
- Generally Mg levels appear to be good with the majority of samples being within or above the target index for both arable and grass crop type samples

Reference

- The target indices are taken from page 104 (arable)and page 179 (grassland) of the RB209 Fertiliser Manual, Defra 2010

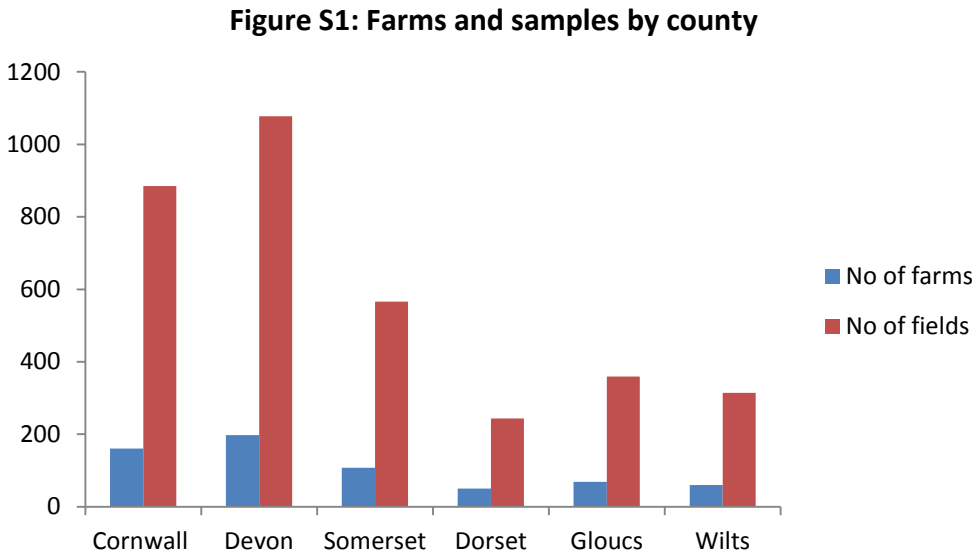


Figure S1: The number of farms participating and samples analysed per county.

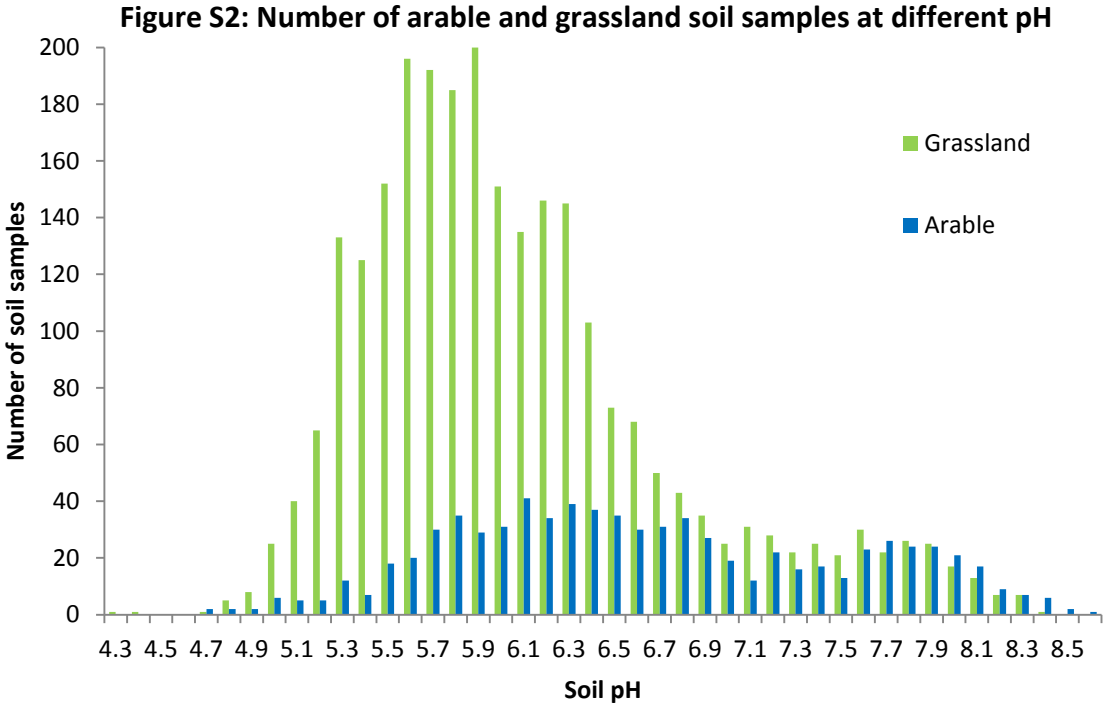


Figure S2: This graph shows the number of arable and grassland soil samples with particular pH values. It should be noted that the modal pH of the grassland (green bars) samples from the South West are within the pH range of 5.5 – 5.9. For arable (blue bars) samples, the modal pH is within the range of 5.8 – 6.1.

Figure S3a: Proportion of arable soil samples compared to target pH per county

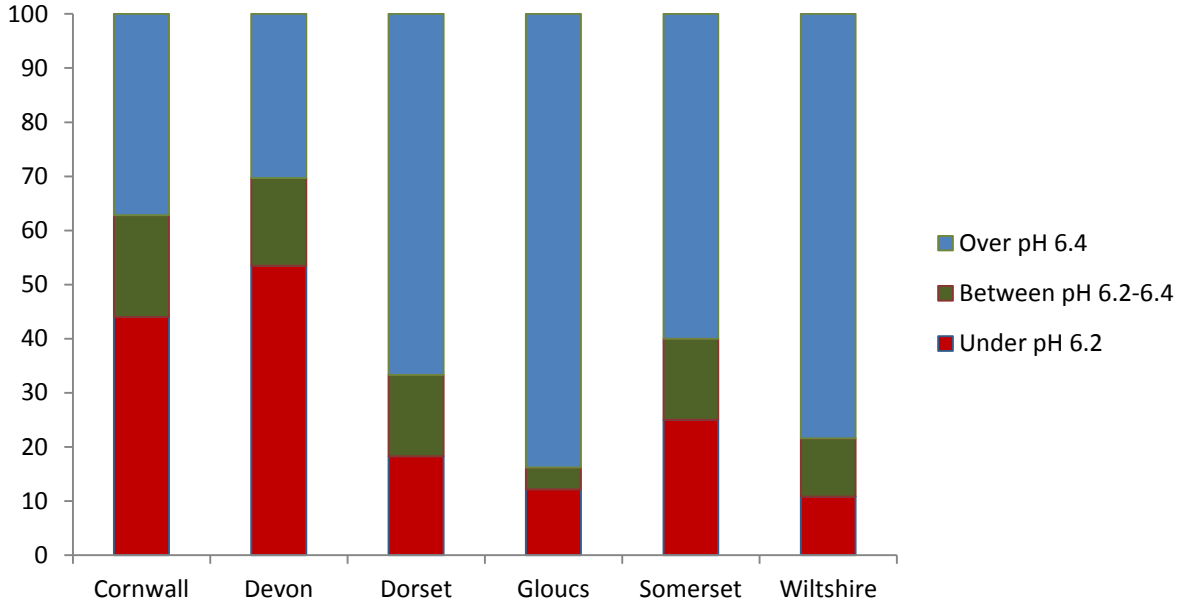


Figure S3b: Proportion of grassland soil samples compared to target pH per county

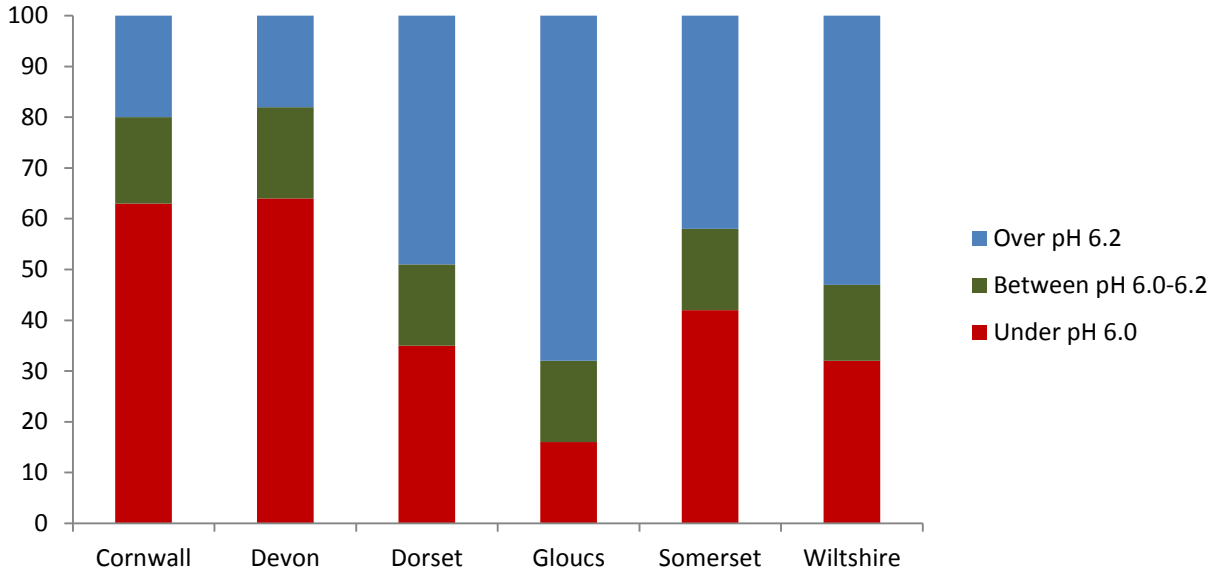


Figure S3: These graphs show the percentage of arable (a) and grassland (b) soil samples that fell outside the target pH for the particular cropping systems. The red areas represent those soils samples that were too acidic, the green areas are those soils samples that met the target pH and the blue areas represent the soil samples that are more alkaline than recommended. The values used in this figure can be seen in Table S1 below.

Table S1: The percentage of arable and grassland soil samples that were under, met or above the target pH range compared by county in the South West.

	Arable			Grassland		
County	**Under target pH**	**Met target pH**	**Above target pH**	**Under target pH**	**Met target pH**	**Above target pH**
Cornwall	44	18.8	37.2	63	17	20
Devon	53.5	16.2	30.3	44	18	18
Dorset	18.3	15	66.7	35	16	49
Gloucs	12.2	4	83.8	16	16	68
Somerset	25	15	60	42	16	42
Wiltshire	10.8	10.8	78.4	32	15	53

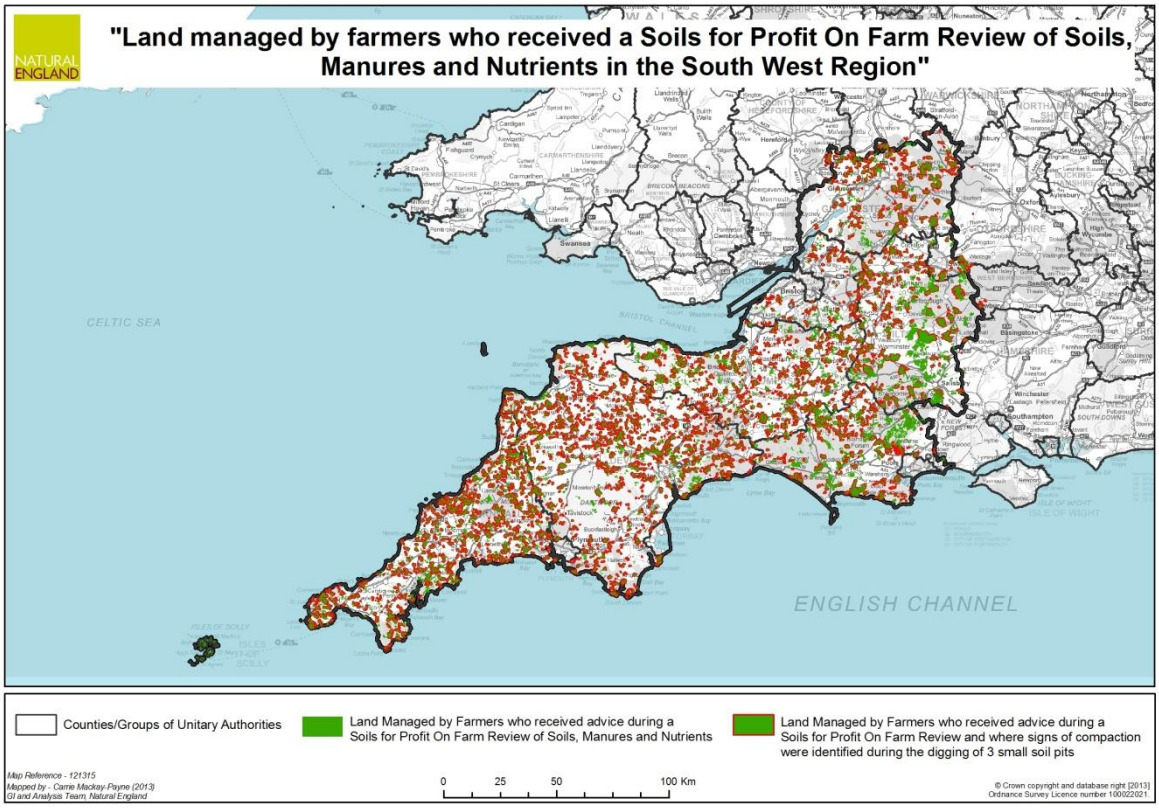
Table S2: The number of **arable** soil samples that were below the recommended SOM benchmark or key nutrient index compared by county.

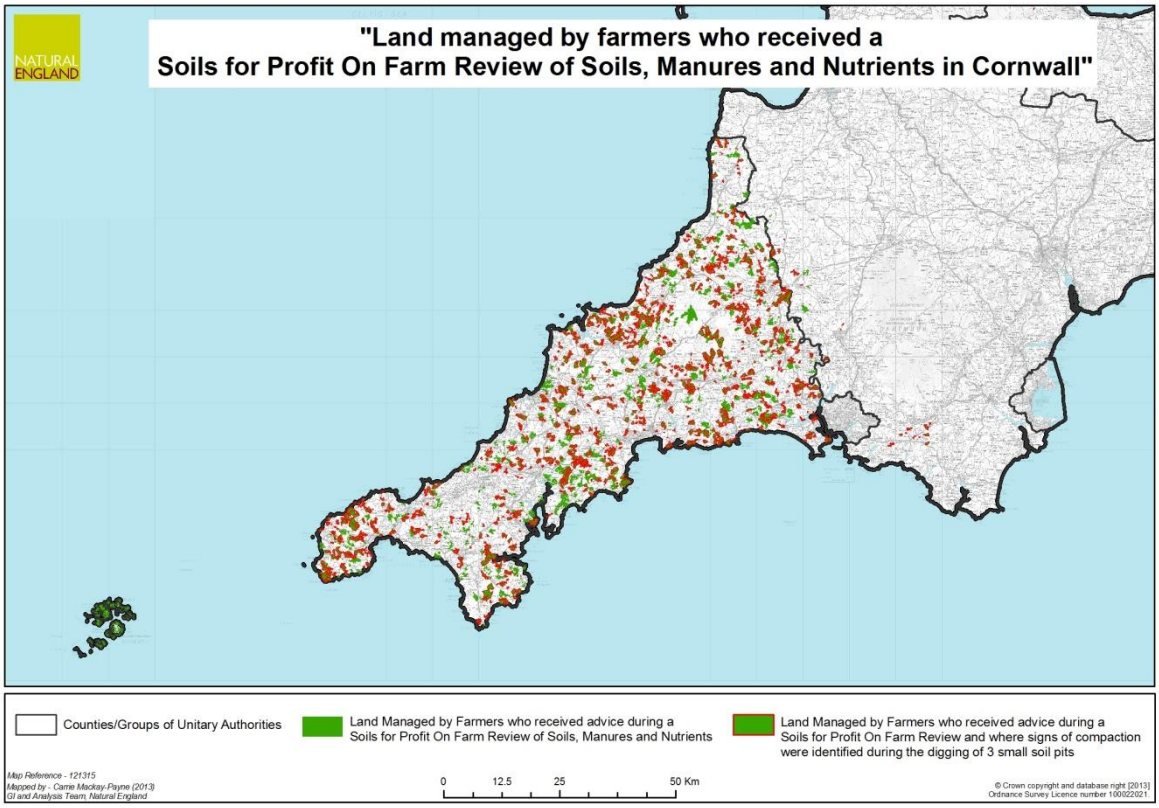
	Total number of arable soil samples	Number of arable soil samples **below** indices			
County		3% SOM	P index	K index	Mg index
Cornwall	218	14	63	80	7
Devon	155	30	45	41	1
Dorset	60	8	20	16	7
Gloucestershire	99	7	31	12	7
Somerset	119	15	35	16	5
Wiltshire	120	13	31	14	19
Total	771	87	225	179	46

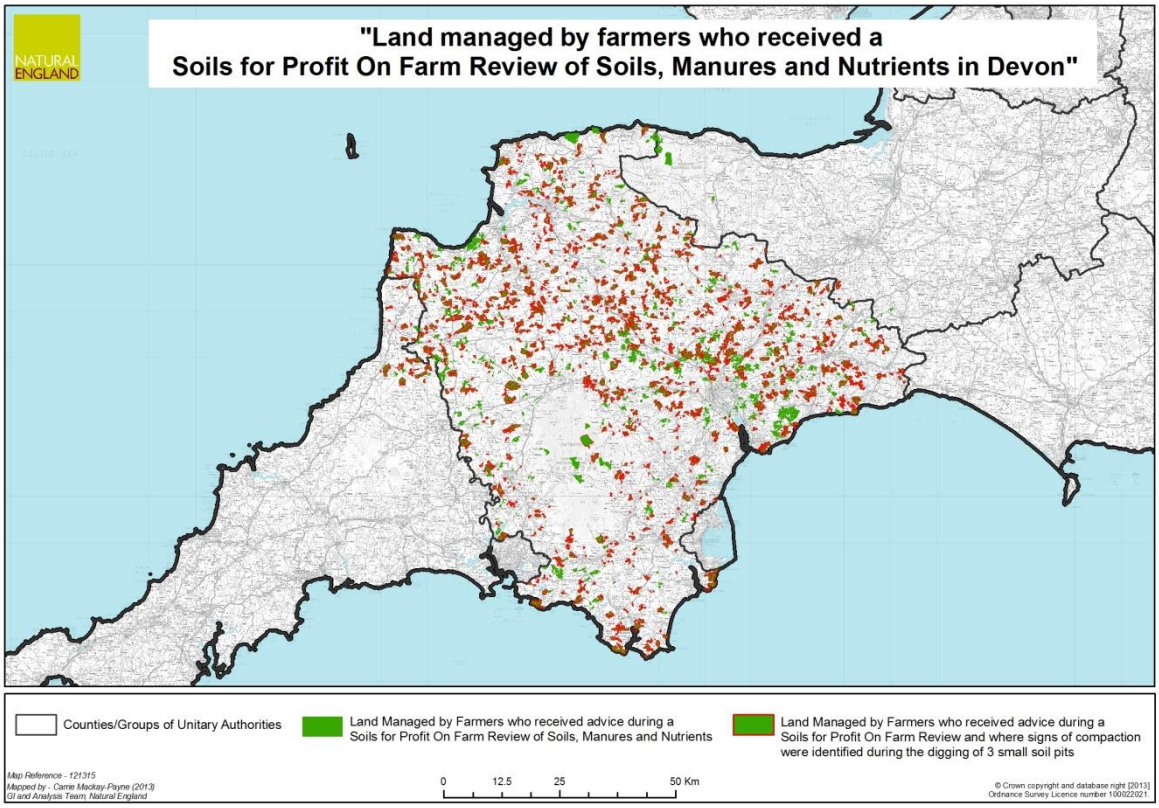
Table S3: The number of **grassland** soil samples that were below the recommended SOM benchmark or key nutrient index compared by county.

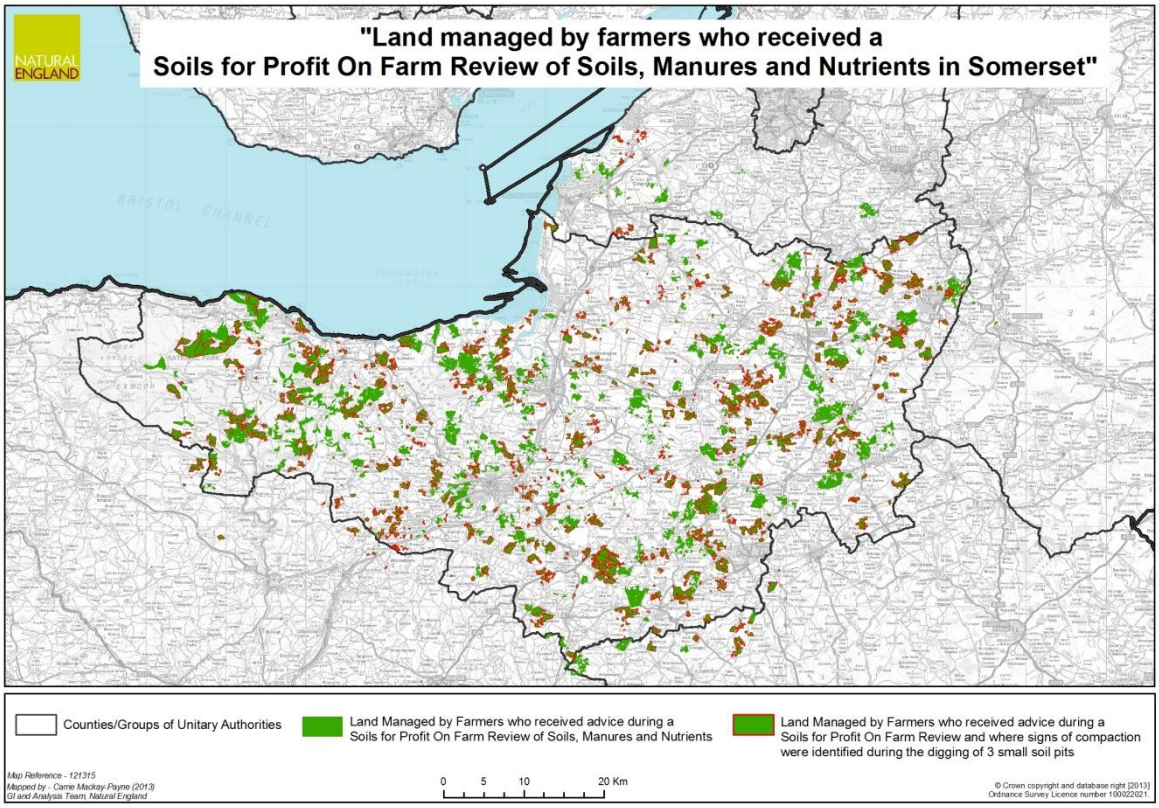
County	Total number of grassland soil samples	Number of grassland soil samples **below** indices			
		3% SOM	P index	K index	Mg index
Cornwall	650	7	259	341	9
Devon	902	11	342	429	8
Dorset	178	6	86	74	4
Gloucestershire	234	5	136	62	1
Somerset	429	8	236	157	11
Wiltshire	185	2	97	58	6
Total	2578	39	1156	1121	39

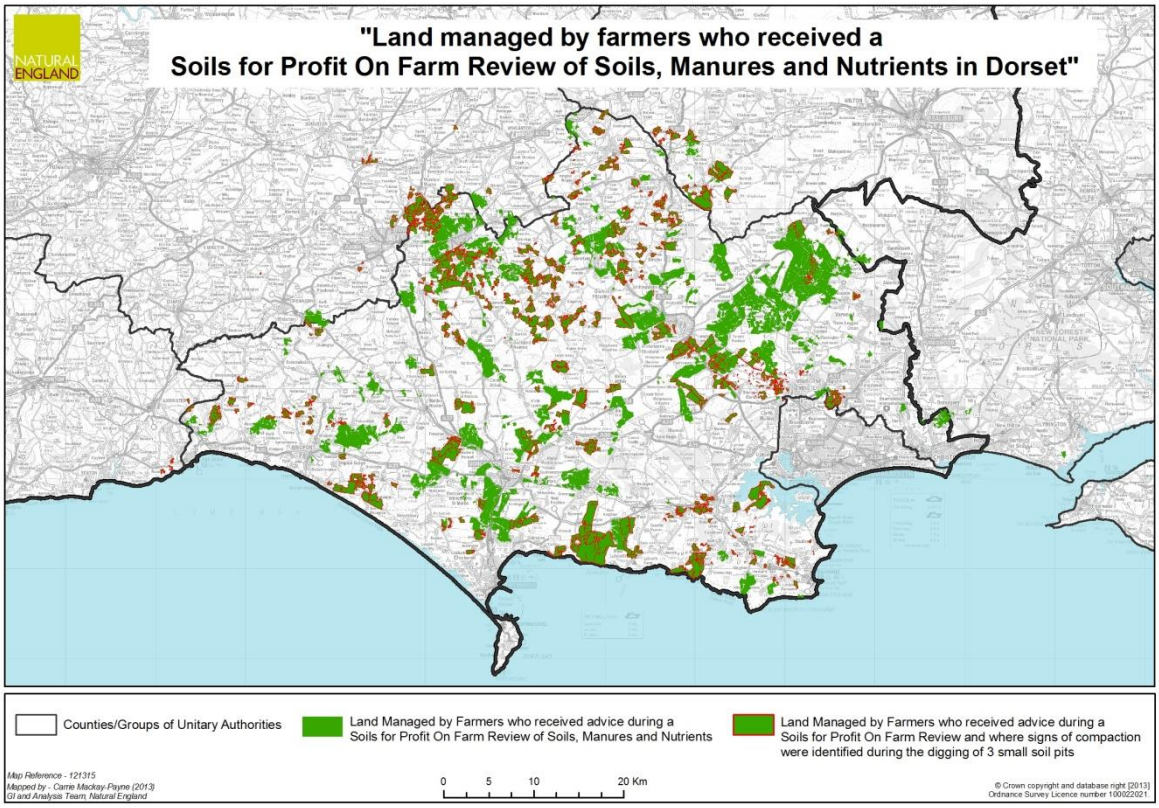
Appendix IX - Land managed by farmers who received S4P advice and where signs of soil compaction were found (SW and county maps)

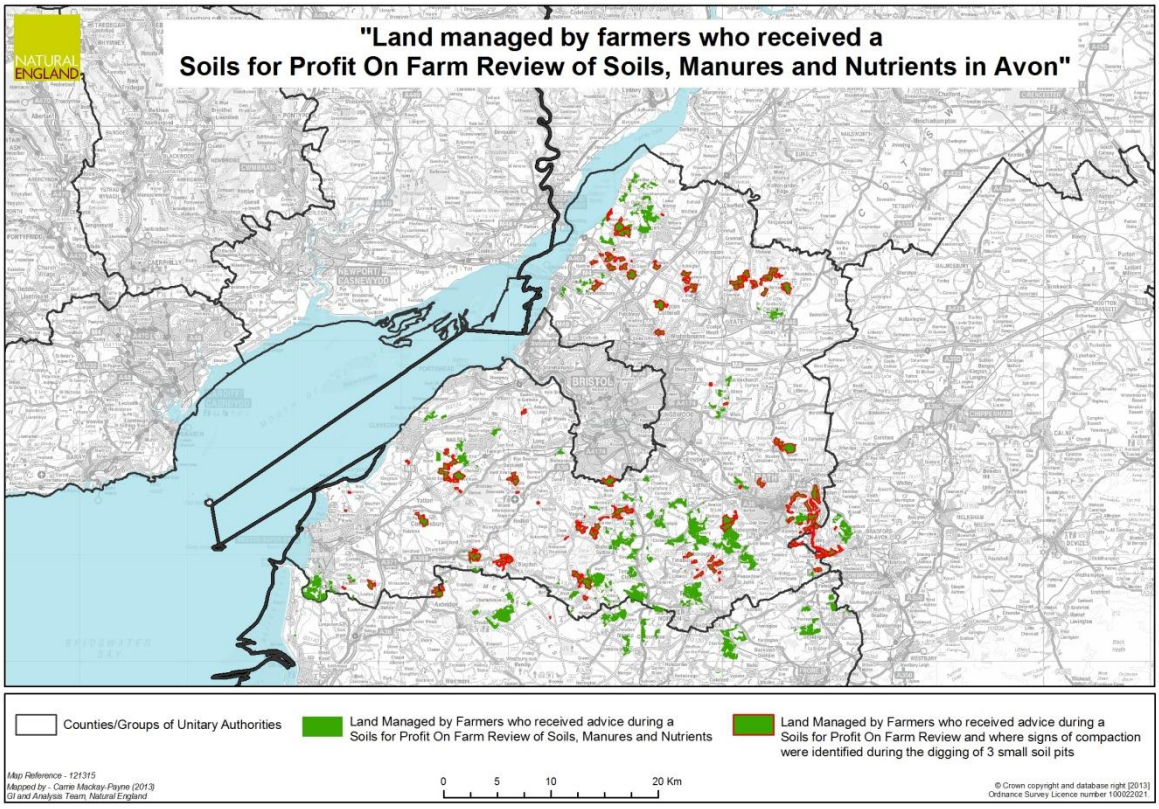


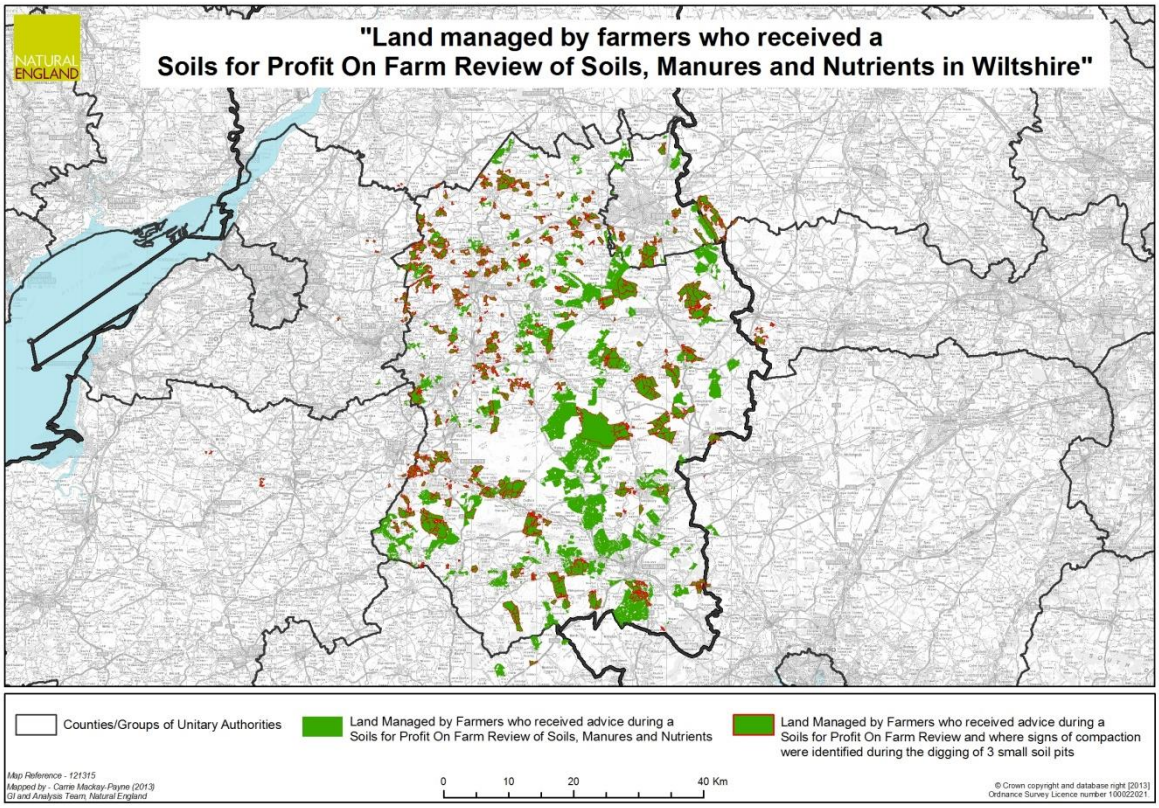

"Land managed by farmers who received a
Soils for Profit On Farm Review of Soils, Manures and Nutrients in Cornwall"
NATURAL ENGLAND
Counties/Groups of Unitary Authorities
Land Managed by Farmers who received advice during a Soils for Profit On Farm Review of Soils, Manures and Nutrients
Land Managed by Farmers who received advice during a Soils for Profit On Farm Review and where signs of compaction were identified during the digging of 3 small soil pits
Map Reference - 121315
Mapped by - Carrie Mackay-Payne (2013)
GI and Analysis Team, Natural England
0 12.5 25 50 Km
© Crown copyright and database right [2013]
Ordnance Survey Licence number 100022021


NATURAL ENGLAND
"Land managed by farmers who received a
Soils for Profit On Farm Review of Soils, Manures and Nutrients in Devon"
Counties/Groups of Unitary Authorities
Land Managed by Farmers who received advice during a Soils for Profit On Farm Review of Soils, Manures and Nutrients
Land Managed by Farmers who received advice during a Soils for Profit On Farm Review and where signs of compaction were identified during the digging of 3 small soil pits
Map Reference - 121315
Mapped by - Carrie Mackay-Payne (2013)
GI and Analysis Team, Natural England
0 12.5 25 50 Km
© Crown copyright and database right [2013]
Ordnance Survey Licence number 100022021

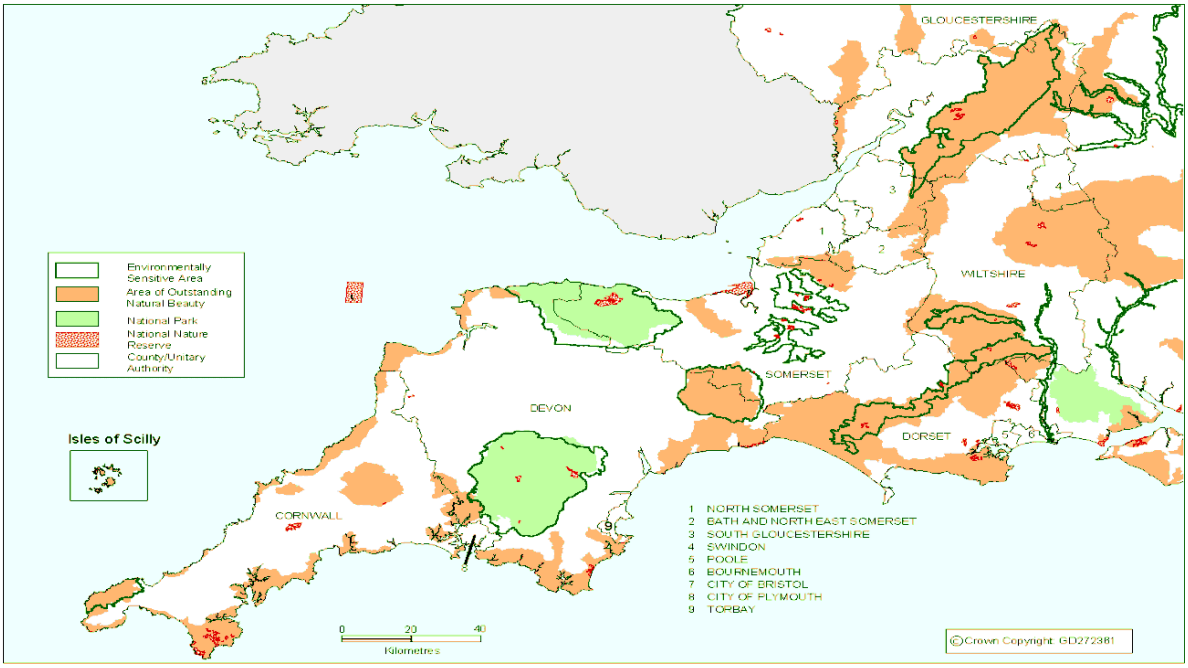

"Land managed by farmers who received a
Soils for Profit On Farm Review of Soils, Manures and Nutrients in Somerset"
NATURAL ENGLAND
BRISTOL CHANNEL
Counties/Groups of Unitary Authorities
Land Managed by Farmers who received advice during a Soils for Profit On Farm Review of Soils, Manures and Nutrients
Land Managed by Farmers who received advice during a Soils for Profit On Farm Review and where signs of compaction were identified during the digging of 3 small soil pits
Map Reference - 121315
Mapped by - Carrie Mackay-Payne (2013)
GI and Analysis Team, Natural England
0 5 10 20 Km
© Crown copyright and database right [2013]
Ordnance Survey Licence number 100022021


"Land managed by farmers who received a
Soils for Profit On Farm Review of Soils, Manures and Nutrients in Dorset"
NATURAL ENGLAND
Counties/Groups of Unitary Authorities
Land Managed by Farmers who received advice during a Soils for Profit On Farm Review of Soils, Manures and Nutrients
Land Managed by Farmers who received advice during a Soils for Profit On Farm Review and where signs of compaction were identified during the digging of 3 small soil pits
Map Reference - 121315
Mapped by - Carrie Mackay-Payne (2013)
GI and Analysis Team, Natural England
0 5 10 20 Km
© Crown copyright and database right [2013]
Ordnance Survey Licence number 100022021


"Land managed by farmers who received a
Soils for Profit On Farm Review of Soils, Manures and Nutrients in Avon"
NATURAL ENGLAND
Counties/Groups of Unitary Authorities
Land Managed by Farmers who received advice during a Soils for Profit On Farm Review of Soils, Manures and Nutrients
Land Managed by Farmers who received advice during a Soils for Profit On Farm Review and where signs of compaction were identified during the digging of 3 small soil pits
Map Reference - 121315
Mapped by - Carrie Mackay-Payne (2013)
GI and Analysis Team, Natural England
0 5 10 20 Km
© Crown copyright and database right [2013]
Ordnance Survey Licence number 100022021


"Land managed by farmers who received a
Soils for Profit On Farm Review of Soils, Manures and Nutrients in Wiltshire"
NATURAL ENGLAND
Counties/Groups of Unitary Authorities
Land Managed by Farmers who received advice during a Soils for Profit On Farm Review of Soils, Manures and Nutrients
Land Managed by Farmers who received advice during a Soils for Profit On Farm Review and where signs of compaction were identified during the digging of 3 small soil pits
Map Reference - 121315
Mapped by - Carrie Mackay-Payne (2013)
GI and Analysis Team, Natural England
0
10
20
40 Km
© Crown copyright and database right [2013]
Ordnance Survey Licence number 100022021

Appendix X Map of South West showing National Parks and AONBs



Appendix XI - References

Agricultural & Horticultural Development Board Dairy Statistics 2016

DEFRA (May 2013) *Greenhouse gas mitigation practices – England Farm Practices Survey 2013 and Farm Business Survey 2011*.12

DEFRA (June 2013) *Agriculture in the English regions 2012 – 1st estimate*

Defra fertiliser management manual – RB209

DEFRA (2017b) – Defra Statistics: Agricultural Facts, England Regional Profiles, January 2017

DEFRA (2017a) – The British Survey of Fertiliser Practice, June 2017

FARM BUSINESS SURVEY (2012) *Agriculture in the South West of England 2010/11*. Prepared for Defra

Marine Biological Association – *Characteristics of the South West European Marine Sites Summary Report 2003*

OLIVER, D. M., FISH, R., WINTER, M., HODGSON C. J., HEATHWAITE, A. L., CHADWICK D. R (2013) Valuing local knowledge as a source of expert data: Farmer engagement and the design of decision support systems *Environmental Modelling & Software,* 36, pp. 76 - 85

O'NEILL, D. (2007) *the total external environmental costs and benefits of Agriculture in the UK*. Environment Agency

NEWELL PRICE, J.P., HARRIS, D., TAYLOR, M., WILLIAMS, J. R., ANTHONY, S. G., DUETHMANN, D., GOODAY, R. D., LORD, E.I., AND CHAMBERS, B.J. *(ADAS)* AND CHADWICK, D. R., MISSELBROOK, T.H. *(Rothamstead Research, North Wyke)*. (December 2011) *An inventory of mitigation methods and guide to their effects on diffuse water pollution, greenhouse gas emissions and ammonia emissions from agriculture.* Prep

THINK SOILS – *Soil assessment to avoid erosion and runoff* – Environment Agency

Natural England works for people, places and nature to conserve and enhance biodiversity, landscapes and wildlife in rural, urban, coastal and marine areas.

www.gov.uk/natural-england