

Best Practice Techniques for Improving Soil Stability and Sustainability Under Pigs

Regenerative farming in action

“As one of the world’s most responsible food producers, the choice is a simple one for us at Cranswick. We don’t want to be part of the problem – we want to be part of the solution. We want to inspire positive change, and lead the way so that others can follow. That’s why we created Second Nature. It’s our climate-ready blueprint for action.”

Adam Couch, CEO – Cranswick plc

Best Practice Techniques for Improving Soil Stability and Sustainability Under Pigs

To devise, and put into practice, the optimum crop rotation around outdoor pigs to deliver minimum bare ground and ongoing improvement in soil health whilst mitigating the risk of soil and water run-off. To then assess the effectiveness of rotational cropping with outdoor pigs in the rotation from both a supply chain interests perspective and farmer's perspective, to help address environmental impacts and increase profitability.

Currently outdoor pigs are perceived to have a poor track record in terms of impacts on water quality and soil health. The best sites for outdoor pig units are free-draining soils but this creates the real potential for direct run-off and infiltration of contaminated water from fields housing pigs, into aquifers, rivers and streams. This contaminated water can contain nitrates and phosphates, which have an adverse effect on the health of both surface waters and groundwaters for drinking water quality.

By thinking about pigs across the whole rotation rather than just about the period pigs are going to occupy the land for, key steps can be implemented to optimise the conditions for both the pigs and the local environment.

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Aims and Objectives

The initial aim of the project is to assess rotational cropping options which will assist in locking in nutrients from the pigs and significantly reduce sediment loss, thereby addressing soil health and water quality issues. This will involve looking at the existing developmental options including cover crops, buffer strips and sediment traps, and place the effectiveness with other measures to reduce outdoor pig production's impact on the natural environment.

Ultimately the project aims to combine compatibility with supply chain requirements for productivity, sustainability and quality of product, as well as to address environmental impacts by introducing near market solutions.

1 Pre-Pigs

1.1

Field Selection

Pigs are best suited to Loamy Sands/Sandy Loams, ideally with a slope of no more than 3° on average across the unit. The majority of land utilised for outdoor pigs is marginal in profitability for many arable crops, generally being drought prone due to lighter texture.

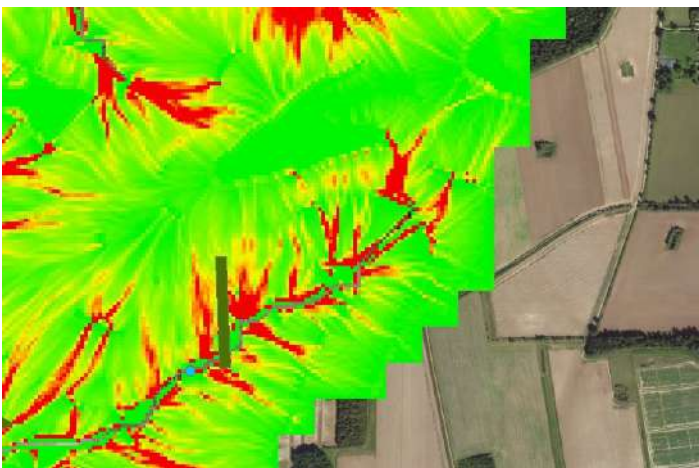
To be successful, the entry into pigs must be more disciplined. Late location changes or late harvest cropping prior to pigs is unsustainable in terms of soil management and environmental protection.

On rented land, field options offered by the landlord can sometimes be changed with little notice. Landlords need to understand the importance of managing soils across the rotation for pig production and realise the benefits that correct pig management can bring to their rotations.

1.2

Risk Mapping

When selecting fields, proximity to water courses and the potential for run-off should always be considered and risk maps can guide this. SCIMAP is a mapping tool of source areas of diffuse pollution problems within the landscape. These areas are where there is a source of a problem (fine sediment for example) and a connection from the source location to the river or lake (Receptor). The locations of the source areas and connection are calculated from a detailed digital elevation model, land cover and rainfall information. This is also combined with other connectivity and Liddar mapping to take into account pathways such as tracks and roadways.



An example of SCIMAP mapping

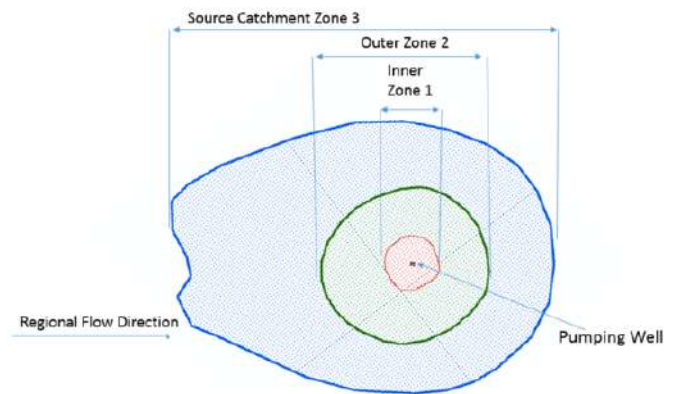
1.3.

Groundwater Source Protection Zones SPZ

Models have been used to estimate how long it will take for a pollutant to travel from the water below ground (any point below the water table) to the source (the point where water is taken) and looks at the area around the source which needs protecting from potential pollutants.

This is split into zones. Zone one (red zone), has the shortest travel time of pollutant to source. No pigs should be put into a red zone (though this is not regulation currently). Zone 2 (green), with a longer travel time of pollutant to source, and zone 3 (blue), the total catchment for an abstraction point, would also ideally not be chosen to have pigs.

All NVZ and nutrient regulations should also be met.



Example model for Source Protection Zone

1.4

Soil Structure Assessment

Soil structural and health assessment should be carried out on a rotational basis. It should be ensured that any identified issues are rectified, and that soil structure is stabilized and in optimum condition prior to the ley establishment. Pre pig occupation establishment is crucial and reduced tillage should be considered to maintain structural integrity. A focus on surface stability will impact infiltration rates for rainfall and reduce erosion.

2 Pigs Across the Rotation

2.1

Stewardship Options

Currently there are many barriers to tenants/short term rents from being able to enter into Country Stewardship. The Norfolk Rivers Trust has been advising on putting in margins and strips which provide multiple benefits. With a more joined up approach, it can be possible to have stewardship options which would fit within the rotation and would offer many benefits.

Some of these are outlined below.



Pollen and Nectar mix

Stewardship options available which could benefit pigs:

Options Before Pigs to Move Onto (Per Ha)

- AB15: 2 Year Sown Legume Fallow - £522
- GS4: Legume and Herb-rich Swards - £309

Options in Field with Pigs (Per Ha)

- AB1: Nectar Flower Mix - £511
- AB8: Flower Rich Margins and Plots - £539
- AB9: Winter Bird Mix - £640
- AB16: Autumn Sown Bumblebird Mix - £550
- SW1: 4m to 6m Buffer Strip on Cultivated Land - £353
- SW3: Infield Grass Strips - £557
- SW4: 12m to 24m Watercourse Buffer Strips on Cultivated Land - £512

Options Post Pigs (Per Ha)

- SW6: Winter Cover Crops - £114
- AB3: Beetle Banks - £573

Capital Items:

- RP7: Sediment Ponds and Traps - £10 sq m
- RP9: Earth Banks and Silt Bunds - £155 per item
- RP11: Swales - £5.95 sq m
- BN11: Planting New Hedges - £11.60 per m

All of these options would have many benefits within a new ELMS scheme.

2.2

Green Cover

Establishing and retaining green cover is vital for soil management and environmental protection when including pigs in arable rotations and new stewardship schemes are becoming increasingly focused on retaining ground cover with its importance in terms of carbon footprint, water quality and biodiversity becoming widely recognised.

Anglian Water studies into soil health on outdoor pig units showed that where there was good grass cover the structure was significantly less affected by pigs.

Anglian Water Soil Health VESS tests scores under different management practices.

VESS (Visual Evaluation of Soil Structure) scores for soil health give a quality score which shows if the soil structure needs to be improved to maintain soil health. A score of Sq1 or Sq2 is good and should only require further monitoring, a score of Sq3 is moderate and may require more frequent further monitoring. Scores of Sq4 and Sq5 are poor and require management action.

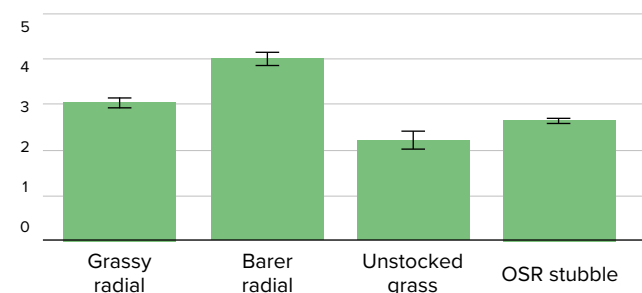
They also showed that where there was good plant cover, the extra Nitrogen provided by the pigs was retained in the soil profile whereas on bare ground it was leached over a wet winter. Retaining nitrogen has multiple benefits for reducing the carbon footprint, improving groundwater quality and for economic return to the arable rotation.

For sustainable soil stability and increased profitability across the rotation of the arable units utilised, Dick Neale, Hutchinsons Technical Manager, believes that the establishment of deep rooting, perennial, legume-based covers/grazing crops is imperative.

The AB15 2-year legume arable ley should be investigated as a key component as the entry to pigs. This option pays £522/ha per year, making it a highly viable option compared to arable cropping on these soils and has great flexibility in species selected. This option would allow for the selection of species which require a long establishment period. Following the 2-year ley, these would provide major benefits during and beyond the pig occupation period.

Legumes, like lucerne and white clovers, if provided with adequate establishment time, provide excellent grazing with deep soil stabilizing roots and excellent regrowth potential if rotationally grazed to allow growth recovery periods. There are some concerns regarding leaving a higher N source behind on top of the pigs. However, most of this Nitrogen would be locked up in the root systems rather than being available N. Although dominated by legumes, grasses would be included, and these take up and retain N.

VESS Scores – Grassed Sow Units



Grasses such as Perennial Ryegrass, Red Fescue, Timothy, Cocksfoot and Tall Fescue are robust and provide grazing interest along with nutrient uptake and storage, but they also require an extended establishment period.

The AB15 2-year fallow mix can be carried forward as the under-pig ground cover. Prior to pigs the growth could be topped, and additional forage rape and stubble turnips sown in to provide initial forage for the pigs.

Initial legume mix would cost circa £45/ha but would initially meet the AB15 requirement. A stitched in forage option prior to pigs would add around £30/ha but soil covers as robust as this option would negate the need for silt trapping and construction. As the original cover is perennial, only a token sown-in addition would be required as regrowth of Lucerne and clover will be significant.

Looking at the gross and net margins of the AB15 legume rich fallow in comparison to a 6t/ha spring barley crop (typical entry for pigs), there is large potential for a different approach as shown in the table below:

	Gross Margin	Net Margin
6t/ha Spring Barley	£395	£158
AB15 2yr Fallow	£465	£373

Obviously the AB15 is for two years but figures above are annual. The margin actually increases for the AB15 in year 2 as you do not have the establishment cost to incur again.

With AB15 the establishment cost of cover into pigs is also already included. Obviously post barley there will be an additional cost of establishing a crop cover pre pigs.

Additional environmental options could be incorporated as field boundary and trackway options.

2.3

Rotational Issues to avoid pre pigs

An initial field assessment will always look at cropping rotation. Below are some of the situations to avoid for entry into pigs:

- **Following Maize**
Late harvest and compaction. – Could undersowing alleviate and provide enough cover? (concerns on light soils)
- **Potatoes/Onions or Other Roots**
Usually late harvest, compaction, bare soil, soil structure issues. Liked by some growers due to pigs removing previous crop volunteers but not good for soil health or for future management of unit.
- **Sugar Beet**
Late harvest, compaction and difficult to manage as above.
- **Winter Wheat in Wet Year**
Late harvest and very little chance of establishing vegetation.

If cover crops were not being used, ideally pigs would follow a Grass ley (1 year – Haylage or AD outputs), if not Winter Barley with grass sown and moving on in spring. Grass leys currently recommended include grasses such as Perennial Ryegrass, Red Fescue, Timothy, Cocksfoot, Tall Fescue.



3 During Pigs

3.1.

Layout of Units

Higher risk areas of a unit include radials due to size, shape, stocking rate and tracks. Farrowing pens seem to sustain more cover due to lower stocking rate. Boars seem to disturb soil more than sows. Setting up of radials and tracks away from high risk areas is important.



3.2

Stocking Rate and Movement of Pigs

Stocking Rate is currently at 25 Sows per Ha and this is not intensified where interventions such as tracks or buffer strips remove land from production.

Observations have found surface runoff and erosion can be higher around radials, therefore reducing stocking rates here can benefit soil structure and green cover. There are obvious barriers around production costs to this.

Flip flap and rotational grazing can have benefits in sustaining some cover and can alleviate any compaction issues on rested land.

Paddock design should consider stocking breaks to maintain periods of regrowth in the covers / forage.

There are also some units moving in the spring, therefore sowing grass after a cereal and having up to 6 months of rest for newly established grass ley.

3.3

Reducing Compaction

Layout of tracks across slopes, feeding in troughs/moveable feeders and low-pressure tyres are all methods to help reduce compaction.

Sub soiling and cultivations of compacted areas and tracks can have beneficial impacts of reducing diffuse pollution through removing surface compaction and improving infiltration.

Ringling of pigs does reduce rooting and therefore reduces removal of vegetation maintaining ground cover for longer and thus reducing poaching.

3.4

Silt Traps and Silt Netting

Interventions such as silt traps, bunds, track cross drains and silt netting are a few methods used to reduce soil and water leaving fields. However, these should always be complementary to in-field good practice to negate run-off and compaction, not replace it.

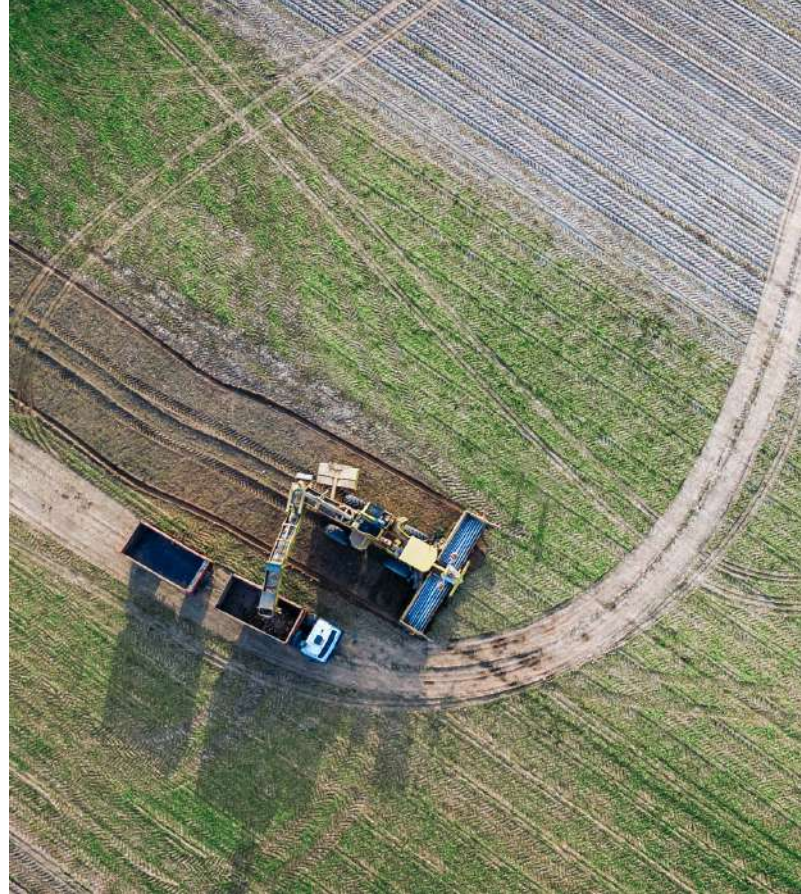
The design and method of installing are bespoke to each situation. Reducing movement of soil and water at the source will reduce the need and size of interventions. Slowing the flow of water throughout the catchment is key with soil management.



Examples of Interventions with Wayland Farms

4 Post Pigs

Pigs are often moved in the autumn leaving sites bare or ploughed before a spring crop (usually sugar beet or maize). If no cover has been kept, getting a cover crop in, with mixed rooting and nutrient retention is key. Overwinter exit covers could add an additional £114/ha.



VESS scores before and after cover crop or bird seed was sown after pigs shows improvements to soil structure.

If grass has been used during pigs and cover kept, cultivating trafficked areas to reduce run-off can be beneficial.

Months after pigs	VESS score
0	3.8
2 (Cover crop)	3.2
5 (Bird seed)	2.8
Track	4.7

Conclusions

To deliver minimum bare ground and ongoing improvement in soil health under pigs, issues need to be addressed across the rotation. This starts with disciplined site selection with no late location changes. Pigs should never follow late harvested crops where compaction is often an issue or where soils have been bare.

The optimum rotation would include the establishment of a deep rooting cover/ grazing crop. This will provide the most robust option for sustainable soil stability.

The AB15 stewardship option has multiple benefits for achieving this. It enables land to be taken on and managed from an early stage and allows for the incorporation of species that require a longer establishment period into the ley but provide major benefits to the soil.

Carrying out a routine soil health assessment prior to establishment of the cover can ensure that any identified issues are rectified, and that soil structure is in optimum condition to produce a healthy cover.

If there are areas of fields which are vulnerable to run-off, intervention such as silt trapping can be utilised. However, the focus should be on prevention of sediment loss within the rotation rather than rectifying the problem when it occurs.

Additional environmental options could also be incorporated as field boundary and trackway options to increase 'greening payment' options.

Consideration of radial or paddock design is important, allowing for rest and recovery periods wherever possible.

Organic Matter results for West Acre Field pre and post pigs showed an increase in the LOI (loss on ignition) from 2.2 to 2.4. between 2017 and 2019. This demonstrates the benefits that pigs can have to soils when properly managed.

Recommendations

- 1 Be disciplined with site selection** – Plan sites in advance within the rotation and with the aid of risk mapping
- 2 Rotationally assess soil structure**
- 3 Include the AB15 (2 Year Sown Legume Fallow) stewardship option into the rotation prior to pig occupation**
- 4 Carry this forward as the under-pig ground cover** – Top and incorporate additional forage rape and stubble turnips to provide initial forage for the pigs
- 5 Set up radials and tracks away from high risk areas and do not intensify stocking rate above 25 sows/ha**
- 6 Use interventions such as silt traps** if there are areas of fields which are vulnerable to run-off.
- 7 Move pigs to maintain periods of regrowth** wherever possible
- 8 Minimize risk of compaction** by considering the layout of tracks/ feeders and use of low tyre pressures
- 9 Use an overwinter exit cover if site is left bare.**



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