BEEF AND SHEEP BRP MANUAL 3

Better Returns Programme

Improving soils for Better Returns

EBLEX

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Better Returns Programme

Delivered by EBLEX

Contents

Soil is the raw material from which most food is produced, and is a precious natural resource. Soil conditions on beef and sheep farms directly influence how well grass and forage crops grow, and the quality of feed they produce.

As soil plays such an integral part in farming, it is important to assess and monitor its chemical and physical properties. Simple tests can highlight shortfalls and surpluses in nutrients, which when corrected, could save farmers significant amounts of time and money.

A spade is one of the most important pieces of equipment when it comes to checking soil health. Digging a hole and handling the top and subsoil can reveal a great deal about its current state and likely future performance.

Compaction is the enemy of good crop growth. Steps must be taken to relieve compacted soils; and everything done to limit compaction in the first place.

Soil management is part of cross compliance and farmers now have an important role to play in preventing degradation through erosion and run-off.

The information in this manual offers useful advice on all these issues, and will help farmers improve returns from crop and animal production through appropriate soil management, while safeguarding it for future generations to come.

Liz Genever
Livestock Scientist
EBLEX

Soils are formed over thousands of years and reflect past geology, climate, vegetation, landscape and human activity.

Healthy, fertile soil is a dynamic living system consisting of biological, physical and chemical components. One gram of healthy soil contains 1 billion organisms including 10,000 different types of bacteria.

Humus – derived from the microbial breakdown of organic matter, plays a crucial role in supplying nutrients for crops and ensuring a good environment in which they can grow.

Test your soil

Like animals, plants need nutrients to grow. If any are in short supply, development will be compromised and performance disappointing.

Any shortfalls can be made up by applying manures, slurries or artificial fertilisers.

A soil test will help decide how many additional nutrients are required, allowing a more targeted approach to fertiliser use, saving time and money.

A £10 soil test can save £1,000s on fertiliser

How to test

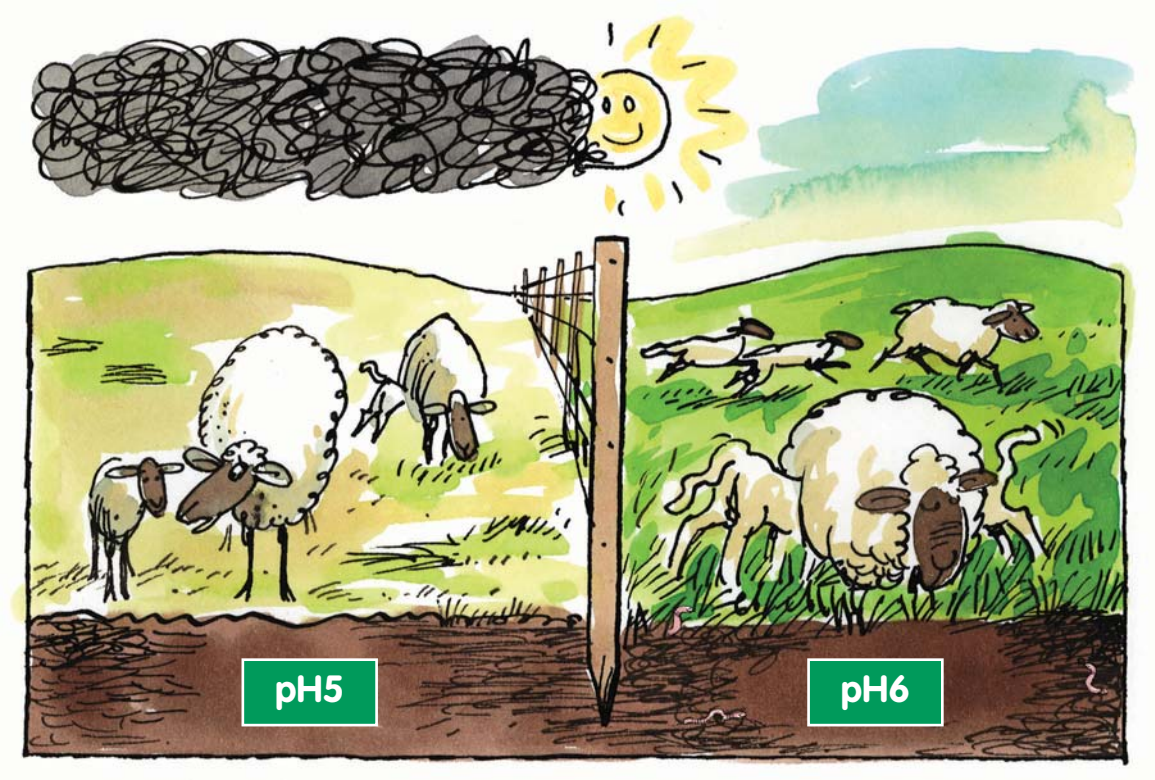
- Twist a sampling auger/soil corer down to 7.5cm
- Walk the field in a 'W'. Avoid gateways/feeding areas
- Collect 25 plugs of soil
- Seal soil in plastic bag and label
- Send to soil laboratory (via local co-op, fertiliser merchant or independent company etc).

Sample about every five years, in the same season and at least two months after the last application of manure, fertiliser or lime.

Include fields that underperform, are going to be reseeded, which receive a lot of muck and slurry or where perennial ryegrass content is noticeably declining.

Lime – the best investment you may ever make

Correcting the pH status of the soil by applying lime is a simple and effective way to increase grassland productivity.



How much lime to apply depends on soil type and liming material. Five tonnes of lime per ha should raise pH by 0.4 units.. Do not apply more than 5t lime/ha in any one season. Do not re-test for a year as it takes between nine and 12 months for pH to increase.

There are many liming products and choice should be based on neutralising value (NV), fineness of grinding and hardness of the parent rock. More details from the Agricultural Lime Association, tel: **0207 963 8000** or go to **www.aglime.org.uk**.

Soil test results

There are four key figures to examine in a standard soil test.

	IF TOO LOW
pH (Acidity) **Essential for:** • Interaction of nutrients • Optimising plant growth.	5 Apply lime (max 5t/ha per application) Monitor effect after 12 months.
P (Phosphate) **Essential for:** • Root development, which provides anchorage, drought tolerance and allows efficient uptake of N.	1 Application of manure/slurry/bagged P. Use different products for different situations: • slow release rock phosphates build up soil levels slowly (cheaper) • instantly available phosphates give quicker plant response (more expensive) Greatest response to P in spring grass.
K (Potassium) **Essential for:** • Transport of nutrients around the plant including efficient movement from root to leaf • Crucial under a cutting system.	1 Application of manure/slurry/bagged K. Currently most expensive nutrient to buy so look for forms to build up levels cheaply eg K in manure is 90% available, with 7.2 kg per tonne.
Mg (Magnesium) **Essential for:** • Reducing the risk of staggers in grazing animals.	0 Apply magnesium lime (15% Mg)

These can all influence how efficiently nitrogen will be used. This may allow a reduction of nitrogen required or a greater yield to be achieved. Nitrogen can be sourced from many places eg artificial fertiliser, legumes, manures, and from the atmosphere.

N (Nitrogen) **Essential for:** • Grass production • Conversion of protein into meat and milk.	Apply nitrogen fertiliser to increase yield eg • 50kg N will give extra 5t DM/yr • 100 kg N will give extra 8t DM/yr.

NB: Always estimate crop demand by accounting for nutrient losses from taking silage/hay cuts and for those supplied by organic manures.

IDEAL	IF TOO HIGH
6 **Remember:** Soil trace elements will be optimised at between pH6 and pH6.5.	7 Heavy cropping will bring pH down ie multiple silage cuts. Naturally very difficult to change.
2 **Remember:** If pH<5.5 or >6.5, P is locked up.	4 Keep to limits set in manure management plan. Avoid further application if at upper limit. Huge risk to the environment from soil loss eg algal bloom in water, this must be avoided. Also wastes money.
2 **Remember:** Do not apply in spring to grazing land to avoid staggers.	4 Can cause: • staggers in livestock • 'luxury' uptake in silage crops which leads to lodging. Excess K is not harmful to the environment. Manage manure application to avoid oversupply.
2 **Remember:** Act on soil test results and identify fields that are more/less prone to staggers in spring and autumn.	4 Reduces K and N efficiency. High Mg soils are difficult to cultivate as it creates big blocks that are hard to break down.
Remember: Too much N can cause high ammonia levels in silage, leading to reduced intakes and potential pollution problems.	N applied above crop demand will be readily lost to the environment, and will waste money.

For more information refer to RB209 Fertiliser Recommendations for Agricultural and Horticultural Crops available free online at www.defra.gov.uk.

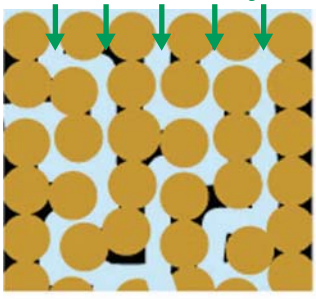
Assess your soil

The physical properties of soil vary between and within fields, at different depths and depending on how it is managed.

Soil Texture

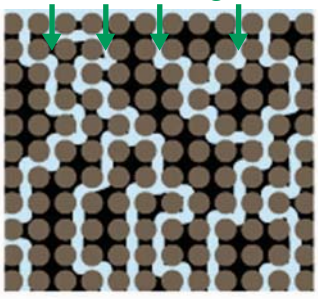
Refers to the relative proportions of clay, silt and sand. These are the main components of all soils but they occur in differing amounts.

Water drains freely



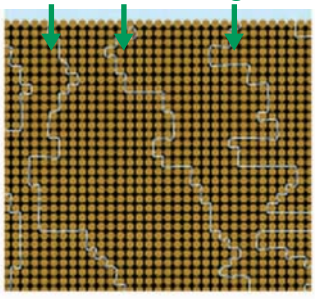
Sand – The largest particles found in soil. These also have the largest airspaces between individual particles through which air can freely circulate and water can easily drain.

Good drainage



Silt – Has smaller particles than sand but bigger particles than clay. The air-pockets and water channels are more restricted than in sandy soils.

Restricted drainage



Clay – The smallest particles found in soil and the spaces between individual particles are also small. Air and water movement is restricted.

Rub some moist soil between finger and thumb to assess soil texture. Sand feels gritty and when moulded into a ball soon breaks up. Silt feels smooth, silky or floury, while clay feels sticky when wet, looks shiny when smeared and will hold a ball shape. Soil texture cannot be changed, but knowing what it is will help when planning future management.

Soil Structure

Refers to the arrangement of the sand, silt and clay particles into blocks.

Good soil structure – characterised by well formed porous blocks with rounded edges, easily broken between the fingers when moist. Vertical fissures lead roots downwards. Hard to damage.

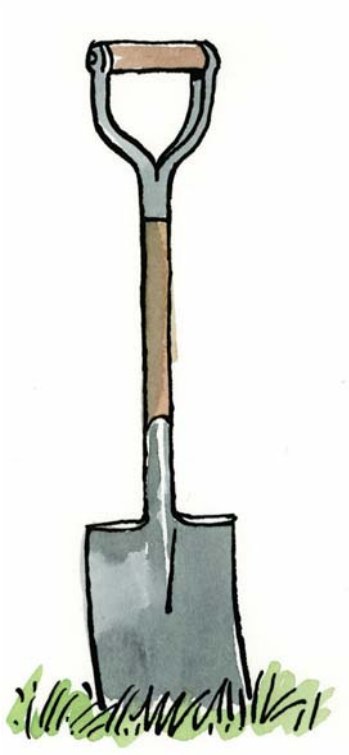
Poor soil structure – much harder, sharper blocks which are more difficult to break apart. Horizontal fissures restrict root growth and development. Easy to damage.

Take a spade

Dig a square hole 50cm wide down to 40cm depth. Lift out a section of soil and examine it carefully.

Assess:

- **Topsoil depth** – shallower under permanent pasture than cultivated soils
- **Colour** – topsoil rich in organic matter will be dark. Rusty, grey mottled soils indicate poor drainage and previous waterlogging
- **Smell** – if water lies trapped in the soil for any length of time, the air-less condition prevents breakdown of organic matter and manures. A foul-smelling dead layer of debris forms
- **Roots** – will extend to 30cm plus in healthy, well structured soil
- **Earthworms** – there should be 10–15 earthworms in the section removed
- **Cracks and pores** – ideally there should be vertical channels 5mm wide between the blocks to allow free movement of water, air and nutrients.



Spot the warning signs

Benefit from good soil management

Compaction

Compaction is where soil has been squashed into a solid, impermeable layer, either at the surface or within the topsoil. This band restricts the movement of air, water, nutrients down through the soil profile.

This type of damage leads to poor root growth, which stresses the plant and reduces its response to nitrogen. Applying fertiliser to compacted soils is a waste of time and money, as the plant will not be able to fully utilise it. The risk of fertiliser run-off will increase by as much as 50–60%.

Compaction can also cause temporary waterlogging. Wet soils stay colder for longer reducing the number of available grazing days. They can also make harvesting difficult, which is likely to reduce the quality of the resulting silage.

Signs of waterlogging

- Standing water
- Reddish tinge to grass leaves indicating stress
- Rushes, marsh thistle and Yorkshire fog
- Scorch marks from urine patches where urine could not drain away.

Identifying compaction

Dig a hole at least a spade's depth when the soil is not excessively wet or dry.

Look how far roots and moisture extend down the profile and for any obvious change in soil structure.

Where the spade meets resistance is where the compaction starts. This depth will give a clue as to the cause.

Compaction type	Typical cause	Remedy
Surface capping (0–10cm deep)	Grazing in wet conditions. High stocking densities. Rainfall on new cultivations.	Lime/introduce organic matter to encourage earthworm activity to break cap. Soil aerator with spikes or knives. Plough.
Machinery (10–15cm deep)	Silage and muckspreading operations. NB the first wheeling creates 70% of the damage so use tramlines if possible.	Soil aerator with spikes or knives. Subsoiler or sward lifter. Plough.
Plough pans (10–15cm deep)	Repeated reseeding at one depth.	Subsoiler or sward lifter. Mole-plough (heavy soils only). Deeper plough just below pan.

Aerator with spikes or knives

Subsoiler or sward lifter

Mole plough

Plough

While compaction can be alleviated in existing swards, it is more commonly tackled as part of a reseed.

DO NOT subsoil established swards in wet conditions or the problem will get worse.

Serious poaching or run-off must be dealt with quickly to meet Cross Compliance rules.

Need to roll?

Roll silage fields only to:

- Push any stones below cutting height
- Level mole hills to avoid soil contamination.

If neither of these is a problem – rolling is a waste of time and money.

Do not roll severely poached areas.

Poaching

Poaching is the name for damage done to grass and the underlying soil by livestock which has been allowed to stand and walk on it for prolonged periods in wet conditions.

Cattle can leave compacted depressions or pockets in the surface of the ground 10–12cm deep in which water can lie. Beneath may be a grey, smelly, unhealthy layer of soil.

These are usually in areas of greatest activity – in gateways or around drinking troughs and feeders.

The destruction reduces grass growth and allows weeds to infiltrate the bare areas.

Sheep damage grassland differently. They are less likely to break the soil surface, but at high stocking densities they pound the ground as a flock, producing a solid compaction layer over a wide area, at 2 to 6cm deep.

How to prevent poaching

- Create multiple entry points to fields
- Outwinter only on light, free-draining, well structured soils
- Use dedicated tracks for moving beef cattle
- Minimise traffic into fields by storing bales close to where they will be fed
- Allow cattle access to a sacrifice area, accepting poor grass performance next season, but knowing that the most important/ productive pastures have been protected
- Feed sheep using a mobile snacker system rather than fixed troughs
- Don't drive across fields in wet conditions.

When poaching is good

In upland areas where pastures are being invaded by tussocky vegetation, less severe poaching by cattle known as pugging is encouraged.

The indentations they create in the soil provide sites for germination of seed from more utilisable grass species.

The impact of poor soil management

Yield

A young grazing ley is capable of producing 12t DM/ha/yr; under a cutting regime up to 14t DM/ha/yr. Permanent pasture can produce 9–10t DM/ha/yr.

However these levels of production can only be sustained in soils that have adequate nutrient reserves and are appropriately managed.

When soils of similar nutrient status are poorly managed, they may only yield 7t DM/ha/yr. This means the farmer may have to buy-in feed to last the winter at much greater cost than it would have been to produce it on-farm.

Quality

Poor soil nutrient content and condition encourages competition from indigenous and less productive grasses. These are less digestible and contain lower levels of energy and protein. This reduces feed quality, animal intake and performance.

Under excellent grazing and soil management, a beef steer can gain 1.2kg liveweight a day on a high quality perennial ryegrass/clover sward. Figures suggest that many producers achieve only 0.6kg liveweight a day off pasture.

Invest in soil inputs

Sheep research at Bronydd Mawr in mid Wales over the past 20 years demonstrates the importance of investing in soils and nutrients for best returns.

	Nutrients applied	Scenario	Stocking rate sustained
Treatment 1	Lime, Nitrogen, Phosphate, Potash	Standard practice	30 ewes/ha
Treatment 2	Lime, Phosphate, Potash	No N	25 ewes/ha
Treatment 3	Lime	No N,P,K	15 ewes/ha
Treatment 4	Nil	No nutrient input	7 ewes/ha

NB: Plots grazed by yearling ewes and single lambs April to August – then ewes alone to November. No silage was made off these plots.

Results

- Increased perennial ryegrass and clover in Treatment 2
- Much shorter grazing season in Treatment 4
- Replacement ewe lambs from Treatment 4 were 6kg lighter than those from Treatment 1 and 2
- Treatments 1 and 2 were commercially viable.

Managing soils under forage crops

There is a risk of soil damage when grazing forage crops in-situ. The key to minimising poaching, runoff and erosion is careful field selection.

Pre-drilling

Identify appropriate fields eg

sandy soils ✓	heavy clay ✘
good drainage ✓	poor drainage ✘
gentle slopes ✓	steep slopes ✘
	near watercourse ✘

The heavier the soil, the more care is needed to avoid damage. Consider reduced tillage techniques for establishment. For example direct drilling brassicas into a sprayed-off grass sward, which provides a "base" to the crop. This reduces soil damage compared to a crop that is established after ploughing.

Pre-grazing

Organise feed fences to provide maximum frontage and a narrow strip of accessible fodder. This ensures the foot pressure of the stock is spread over the field rather than concentrated in one area.

Avoid vehicles travelling in the field during winter by putting bales of silage, hay or straw out in the summer. Plan how many bales will be required to last the winter.

If the field has steep areas, start grazing the crop across the slope at the top, so any runoff will travel through the standing crop.

Think about where the feeder for the fibre source and the water tanks are going to be placed to reduce poaching in these areas. Move regularly or place on a hard standing.

Post-grazing

Where necessary, cultivate as soon as conditions allow to remove wheelings and compaction. Rough-plough sandy and silty soils following harvest to produce a cloddy, coarse surface that is less likely to cap.

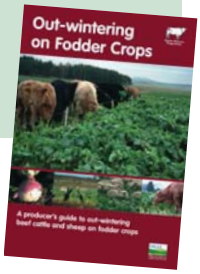
Following harvest, check for soil damage and remedy any problems. Sow the next crop within ten days of cultivating and establish ground cover as quickly as possible.

More info:

Controlling Soil Erosion, Defra manual (PB4093)

Cross Compliance Guidance for Soil Management (2010 edition) PB13315

Out-wintering on Fodder Crops, BRP Manual, EBLEX.



Managing soils under forage maize

Growing maize can cause soil damage at sowing and harvest. Ground cover is slow to develop after drilling in spring, leaving the surface susceptible to soil erosion. Harvesting in autumn can lead to soil structure damage due to heavy trafficking. The bare ground left is open to erosion and soil wash.

Pre-drilling

Avoid growing maize on marginal areas and fields with high erosion risk. Sow early maturing varieties, so they can be harvested before soils become waterlogged.

Prepare seedbeds carefully to reduce soil compaction so as not to leave wheelings that could hold water. Leave adequate buffer zones between the crop and any water sources.

Post-harvest

Harvest across the slope wherever possible, to reduce the problem of tracks providing channels for water to flow down.

Sloping headlands should be subsoiled and cultivated as soon as possible after harvest.

Choose the correct cultivation method for soil type; on well structured soils use minimal cultivation, on compacted soils use a plough or subsoiler.

The timing of cultivations relative to a rainfall event is critical. Ideally, after cultivation there needs to be at least 24 hours of dry weather to help set and stabilise the soil. If this does not occur severe soil erosion on high risk fields can result.

Manures

Apply organic manures in response to crop needs only – avoid slurry dumping. Ensure NVZ regulations are adhered to when spreading FYM and slurry.

If large amounts of wet slurry are applied to maize stubbles, infiltration can be dramatically reduced if the slurry dries and seals the soil surface.

More info:

The Maize Growers Association
www.maizegrowersassociation.co.uk

Controlling Soil Erosion, Defra manual (PB4093)

NB. The use of forage crops and maize, and how any soil damage will be remedied, has to be noted in the Soil Protection Review for cross compliance.

Managing soils for cross compliance

Soil management is part of cross compliance, and is part of maintaining land in Good Agricultural and Environmental Condition.

Defra's objective is to improve the agricultural potential of soils and reduce any negative impacts on the environment. Producers must identify and address the risks in a Soil Protection Review. A copy must be available at a Rural Payments Agency inspection.

There have been recent changes to the cross compliance rules. While many of the issues may be more relevant to arable farmers, livestock producers still need to be aware of the requirements.

In the Soil Protection Review farmers must:

- identify and record current and potential problems
- assess and record soil type and degradation risks
- take appropriate measures to prevent and/or put right any problems
- review risks and measures each year.

High risk activity for grassland soils:

- Silage making with loaded trailers
- Spreading manures and slurry in wet conditions
- Grazing when the soil is too wet, particularly when strip grazing
- Out-wintering
- Reseeding grassland
- Static feeders/troughs
- Overgrazing with loss of vegetation cover.

More info:

Cross Compliance Helpline – 0845 345 1302

Single Payment Scheme – Cross Compliance Guidance for Soil Management, 2010 edition. Defra publication PB13315

Soil Protection Review 2010. Defra publication PB13311

Controlling Soil Erosion. Defra publication PB4093

Environmental stewardship

When applying to Natural England for an Entry Level Scheme (ELS) or Organic Entry Level Scheme (OELS), a Farm Environment Record must be produced to identify fields where water erosion, wind erosion or runoff occurs, or could do so.

The option to produce a Soil Management Plan to gain points is no longer available. However a range of options that focus on soil, such as management of maize crops to reduce soil erosion, is available.

More info:
Natural England at www.naturalengland.org.uk/es
Campaign for the Farmed Environment at www.cfeonline.org.uk

Environment Agency

The Environment Agency (EA) is responsible for environment regulation of major industries and agriculture, flood risk management, navigation, fisheries, ecology, water quality and resources and climate change.

A Soils Strategy launched in 2007, identified the roles and responsibilities of the EA for soil, setting out priorities and action to be taken using regulation, advice, incentives and partnerships.

EA publications include:

Best Farming Practices – explaining how using resources wisely can help farmers cut costs while maintaining or improving productivity.

thinksoils Manual – aimed at farmers and advisers to help them recognise problems with soil erosion and runoff from agricultural land. It is a useful and practical guide to soil assessment, and helps identify high risk areas.

More info:
Environment Agency at www.environment-agency.gov.uk
thinksoils information line: 0870 8506 506

Catchment Sensitive Farming

Agricultural sources are estimated to account for 75% of sediment in at-risk rivers.

Catchment Sensitive Farming (CSF) is a joint venture between Natural England and the Environment Agency funded by Defra. The aim is to tackle Diffuse Water Pollution from Agriculture (DWPA) in order to meet the objectives of the EU's Water Framework Directive.

Even in the absence of obvious soil erosion, runoff from agricultural land may carry very fine soil particles, soluble pollutants such as plant nutrients and pesticides, or manures into water courses.

CSF encourages best practice in:

- promoting good soil structure to maximise infiltration of rainfall and minimise runoff and erosion
- protecting watercourses from faecal contamination (eg by fencing), and sedimentation and pesticides by using buffer strips
- use of fertilisers, manures and pesticides
- reducing stocking density or grazing intensity
- reverting arable to grassland.

Environment Agency
defra
A clear solution for farmers
ENGLAND CATCHMENT SENSITIVE FARMING DELIVERY INITIATIVE
NATURAL ENGLAND

More info: www.defra.org.uk

Other BRP publications available

Beef BRP

Manual 1 – Choosing bulls to Breed for Better Returns
Manual 2 – Beef selection and handling for Better Returns
Manual 3 – Improving cattle handling for Better Returns
Manual 4 – Beef production from the dairy herd
Manual 5 – Feeding suckler cows and calves for Better Returns
Manual 6 – Improve beef housing for Better Returns
Manual 7 – Feeding growing and finishing cattle for Better Returns

Sheep BRP

Manual 1 – Target Lamb Selection for Better Returns
Manual 2 – Target Ram Selection for Better Returns
Manual 3 – Target Lamb Management for Better Returns
Manual 4 – Target Ewe Management for Better Returns
Manual 5 – Target Store Lamb Management for Better Returns
Manual 6 – Target Easier Management for Better Returns
Manual 7 – Target Lameness for Better Returns
Manual 8 – Target Worm Control for Better Returns
Manual 9 – Improving ewe breeding for Better Returns
Manual 10 – Controlling external parasites for Better Returns
Manual 11 – Target ewe fertility for Better Returns
Manual 12 – Improving ewe nutrition for Better Returns

Joint Beef and Sheep BRP

Manual 1 – Improving pasture for Better Returns
Manual 2 – Improved costings for Better Returns
Manual 3 – Improving soils for Better Returns
Manual 4 – Managing clover for Better Returns

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