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Feed planning for cattle and sheep

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Check list for successful feeding planning

1. Take a broad look at your system ☐ *See page 1*
- Is the feeding system right?
- Is waste minimised?
- Are there any big changes that could be made to improve performance eg, contracting out heifer rearing, changing grazing or winter feeding system?

2. Work out the energy requirements of all stock over a year of production ☐ *See page 3*

3. Work out the current feed conversion efficiency ☐ *See page 4*

4. Know the nutritional content of the grass, silage, forages and bought-in feeds ☐ *See page 5*
- Energy content
- Protein content
- Digestibility
- Minerals

5. Monitor stock performance to make sure the feeding regime is right for the system ☐ *See pages 6–8*
- Milk record
- Measure liveweight and weight gain against targets
- Body condition score
- Blood profiles

6. Work out a whole-farm feed plan ☐ *See pages 9–18*
- STEP 1 – Work out annual energy demand
- STEP 2 – Work out annual energy supply from grazed grass, conserved forages, bought-in concentrates and straights
- STEP 3 – Subtract Step 1 from Step 2 and assess where the energy balance lies

7. Set targets for improvement ☐
- Is more production from grazed grass and conserved home-grown feeds possible?
- Use bought-in feeds as efficiently as possible
- Focus on attention to detail

8. Consider other factors ☐ *See pages 20–23*
- Animal health
- Protecting the environment

Feed planning for cattle and sheep

Matching the amount and quality of home-grown forages and bought-in feeds with animal production requirements is central to running a successful livestock business.

Getting the balance right is crucial for generating an efficient system that has minimal detrimental impact on the environment while optimising animal performance.

Livestock should be fed rations that have been properly balanced for energy, protein, minerals, and vitamins. This will ensure their nutrient requirements are met and not exceeded which would lead to waste and inefficiency.

Taking a bottom-up approach to feed planning, starting by calculating the amount of nutrients the animals need to perform to expected levels, calculating what can be grown on-farm, then filling any gaps with purchased feeds, provides an opportunity for farmers and industry to enhance profitability whilst protecting our surroundings.

Fresh look at feeding

The information provided within this publication will allow ruminant livestock farmers and their advisers to take a fresh look at feed planning, to see how it might be improved.

This guide, along with the other Tried & Tested publications, can help farmers fully integrate their use of manure, fertilisers and feeds into a more complete, whole-farm nutrient plan.

There is a real win:win to be gained by balancing nutrient input to nutrient use on-farm; costs can be reduced and gains made from improving efficiency.

Taking action to achieve these will reduce the over-supply of nutrients to the system, lessening the risk of harmful losses to the environment.

Whenever appropriate, it is recommended that farmers make use of widely available ration formulation programmes, and discuss with a registered feed adviser (www.feedadviserregister.org.uk) or nutritional consultant, specific actions that aim to improve overall performance and efficiency.

Measure

- Nutrients in soils, manures
- Nutrients in grass, forage crops, silages, bought-in feeds
- Grazed grass and silage yields
- Animal performance – milk yields, growth rates, dry matter intakes, health and fertility
- Feed conversion efficiency

Think

About the strategic objectives of the enterprise.

Set targets for production, feed efficiency, financial returns, environmental impact and marketing of the end product

Plan

How to achieve the objectives.

Draw up:

- A soil management plan
- A crop nutrient management plan
- Feed plans for feeding grazed grass in summer and conserved forages in winter
- Targeted performance programmes for each livestock enterprise
- An animal health plan

Act

Make changes that will make the business more efficient and protect the environment, eg

- Ration stock separately according to level of performance
- Reduce wastage at feeding out
- Change calving period
- Introduce red clover
- Contract out heifer rearing
- Target manure applications to meet grass and crop requirements

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Nutrient requirements for ruminant production

The categories of nutrients required for all animals to grow, thrive and produce milk and meat are energy, protein, minerals and vitamins. The critical ones for practical rationing on farm are energy and protein, as these are the most costly nutrients to supply.

Energy

The 'Feed into Milk' model derives a dairy cow's requirement for energy (Metabolisable Energy (ME)) by taking into account factors including liveweight, liveweight change, milk energy output, milk fat, efficiency of energy use, pregnancy and the energy density of the diet. ME is expressed as megajoules per kilogram dry matter (MJ/kg DM).

The cow's response to energy depends not only on the amount supplied, but also on the way the carbohydrates and fats are presented. Carbohydrates like simple sugars and starches and more complex hemicellulose and cellulose are fermented in the rumen and broken down to volatile fatty acids to provide the energy required.

For beef cattle and sheep the ME requirements are based on the requirements for maintenance, growth, pregnancy and lactation.

For basic feed planning, it is the overall ME requirement that is important, irrespective of how that requirement is met by grass, forages, or other feeds.

Sugars and starch

Sugars and starch increase the rate of fermentation in the rumen. However, high levels may result in rumen acidosis, while too little will result in rumen microbes not having enough readily fermentable energy for protein synthesis.

Fibre

Dietary fibre made up of structural carbohydrates such as cellulose, hemicelluloses and lignin, is required for normal rumen function and development. This is measured and reported as Neutral Detergent Fibre (NDF) and is digested at a slower rate than rapidly fermented sugars and starches.

Excess NDF reduces the rate of fermentation and reduces feed intake, but too little fibre leads to rapid rumen fermentation and potential acidosis.

Protein

In ruminant diets protein is expressed as crude protein (CP), which is a simple measure of the nitrogen content of a feed. This is measured as the nitrogen content of the food multiplied by 6.25, as it is assumed the nitrogen content of protein is 16%. It is expressed in feed analysis as grams per kilogram dry matter (g/kg DM) or as % DM.

The proteins in feeds are broken down in the rumen – known as Effective Rumen Degradable Protein (ERDP), to the building blocks of amino acids and ammonia. These are taken up by the rumen microbes and reformed into the protein the animal requires to live, grow and produce milk and offspring.

Feeds are characterised by the extent to which they are degraded in the rumen to provide nitrogen for microbial protein synthesis. Metabolisable protein is supplied from both microbes and from by-pass protein which is digested in the intestine.

At some stages of production, such as early lactation or for prolific ewes in late pregnancy, higher quality protein is required that is not broken down in the rumen, ie undegradable protein (DUP.) This form of protein passes through the rumen and is digested by the animal in its lower gut.

It is beyond the scope of this publication to cover all possible feeding scenarios and diets in terms of energy AND protein content. Therefore the focus is on ensuring the feed supplied at least meets the overall energy requirements of the animals.

Farmers following a whole-farm approach must also ensure there is enough RDP and DUP in the diet to meet production targets for each class of stock at their particular stage of production.

Fats

Fats are composed of different fatty acids and act as important sources and stores of energy. Although the ruminant can manufacture many of these, there are some essential fatty acids that must be supplied in the diet. They form important parts of cell walls and are involved in energy transfer.

Fats increase the energy density of the ration because they have a much higher ME content than carbohydrates. However, their inclusion should not exceed 5–6%, as at high levels they coat the rumen microbes which reduces their fermentation capacity and efficiency.

Minerals

The major minerals, such as calcium (Ca), phosphorus (P), potassium (K), magnesium (Mg), sodium (Na) and sulphur (S) are used by animals for many physiological functions that contribute to production.

The minor minerals, such as copper (Cu), cobalt (Co), selenium (Se) and zinc (Zn), are no less important than the 'major' ones, they are just needed in smaller quantities. However, they are essential to animal maintenance, growth and health.

Water

Water is essential for carrying nutrients around the body, rumen fermentation and digestion, control of body temperature and as a major component of milk.

A dairy cow yielding 45 litres of milk requires approximately 120 litres of water per day. It is essential that an adequate supply of good clean water is available to all stock.

How much do animals need?

The key nutrients which affect the performance of dairy cows, beef cattle, and sheep are energy and protein. This publication focusses on providing guidelines for these nutrients to assist in whole-farm nutrition planning rather than drawing up individual rations.

The other nutrients are not as important for working out the gap between what can be provided from home-grown grass and forage, and what has to be bought-in.

Animals need energy and protein to

- Maintain their life processes, including pregnancy
- Produce milk and meat

For dairy cows

Table 1: Guidelines for the daily energy allowance for maintenance

Liveweight (kg)	*ME allowance (MJ/day)*
450	50
550	70
650	80

Daily energy required for milk production is 5.3MJ ME/litre milk.

A 650kg cow producing 7,500 litres in a lactation will need (80 x 365) + (5.3 x 7,500) = 68,950MJ ME over the course of a production year.

This same cow will need approximately 650kg of CP over the year plus or minus 120kg CP for every 1,000 litres variance from the 7,500.

For growing animals

Guidelines for maintenance of growing beef animals.

Allow for 11MJ ME per day maintenance for every 100kg liveweight, plus 47MJ ME/day for every 1kg of liveweight gain. Each kg of liveweight gain will also require approximately 450g of CP.

For suckler cows

Table 2: Energy and CP required by suckler cows over a year

Breed type	*Approx. weight (kg)*	*Energy (MJ ME)*	*Protein (kg CP)*
Small	450	26,500	215
Medium	500	29,500	245
Large	575	31,500	255
Very Large	650	37,000	305

For ewes with lambs

Nutrient requirements of ewes change throughout their annual production cycle, increasing significantly during the last six weeks of pregnancy, and being greatest during the first six to eight weeks of lactation.

Table 3: Nutrient requirements of ewes carrying a single lamb over a year

Approx. ewe weight (kg)	*Energy (MJ ME)*	*Protein (kg CP)*
40	3,450	30
60	4,600	41
80	6,100	52
100	7,650	65

Table 4: Nutrient requirements of ewes carrying twins over a year

Approx. ewe weight (kg)	*Energy (MJ ME)*	*Protein (kg CP)*
50	4,350	39
60	5,100	46
80	6,650	60
100	8,300	75

For growing lambs post weaning

Table 5: Daily nutrient requirements of lambs growing at 150g/day

Lamb weight (kg)	*Energy (MJ ME)*	*Protein (kg CP)*
10	4.2	67
15	5.7	69
20	7.1	70
25	8.5	72
35	11.7	89
45	15.1	107

Measure

- Work out how much energy the system requires by using the figures shown to calculate approximately the energy required for all the animals over a year
- Work out how much energy and protein is produced on farm in terms of grazed grass, silage and forage crops/cereals. The feed planning forms on pages 12–17 will help to do this

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Feeding efficiency

Benefits for farmers and for the environment

The efficiency of a system can be measured by how much feed it takes to produce a certain amount of meat or milk. It becomes increasingly important during times of decreased profit margins.

For meat production, typically around 5.5–6.5kg DM of feed is used to produce a kg of meat. In finishing systems and where dairy type animals are being reared for beef, these values can be as high as 8–12kg DM feed per kg of meat. The lower the number, the more efficient the system.

For milk production, feed conversion efficiency is usually expressed as milk produced per kg of DM fed. Typical figures are between 0.8 and 1.8kg milk per kg of DM fed. The higher the number, the more efficient the system.

Other factors

The efficiency of feeding is not only influenced by the system. Breed of animal, stage of production (weight and age), energy density of the feed and yield level all have an effect.

Whatever the system, improving the conversion of feed into product will increase profits, while reducing any nutrient surplus and risk of losses to the environment.

Keys to improving feeding efficiency.

- Know the feed conversion efficiency of the enterprise
- Find out the nutritional analysis of the forage and non-forage feeds fed
- Set targets for where the system should be and how it is to be operated, ie production levels, grazing/forage system
- Focus on getting the details right. It is not the system that matters so much, but the way it is managed

Improving feed efficiency increases profits.

- All feeds cost money. The less fed to achieve production targets, the better the net margin of the enterprise will be
- Generally, the more production is derived from home-grown forage, the cheaper the system will be to operate and the more margin will be made

For example, if grazing has a unit cost of one, typical silage systems have a unit cost of around two. Energy-dense concentrates have a unit cost of four.

Improving feed efficiency reduces impacts on the environment.

- The greenhouse gas (GHG) emissions involved in producing, storing and feeding home-grown and bought-in feeds are a large part of the GHG emissions from livestock farming. Using less per unit of production will reduce GHG losses
- All feeds contain the N and P needed to run the system. These are the same nutrients that can be lost and harm the air and water around the farmed environment. So the less feed used per unit of production, the lower the risks of losing N and P
- If animals can more efficiently convert their feed, less manure will be produced, requiring less manure storage, reducing the risk of manure spillage, and the forced spreading of manure in less than ideal situations

Measure

- Work out what the current feed conversion efficiency is
- Calculate the tonnes of feed DM fed and divide this by the tonnes of milk and/or meat produced

Rule of thumb

- Feed conversion efficiency = kg feed DM eaten per kg of meat liveweight or litres of milk produced per kg of dry matter intake
- Typical figures:
  Meat production – 5.5 to 6.5kg DM eaten per kg liveweight gain
  Milk production – 1 to 2 litres produced per kg DM eaten

Challenge

- Can feed conversion efficiency be improved by reducing wastage?
- Can profitability be increased by more closely matching bought-in feeds to requirements?

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Sources of nutrients

Home-grown feeds

To optimise ruminant performance it is essential to maximise output from forage by applying good growing, preservation and storage techniques. Grass, maize, and wholecrop cereal silages form the basis of most winter feeding programmes but can show wide variations in quality both between farms and also within the same farm. This can signifcantly affect animal performance potential.

Wet silages result in reduced total DM intakes and cause balling and physical separation of mixed rations. Very dry forages may lead to greater sorting and increased risk of acidosis.

The difference in ME between the poorest silage and the average can equate to around 5 litres of milk. Second cut silages tend to have lower digestibility and ME than first cut.

Low protein in silages may indicate late cutting of very mature grass with low intake potential, while high protein levels may reflect the inclusion of clover or indicate late or over applied fertiliser.

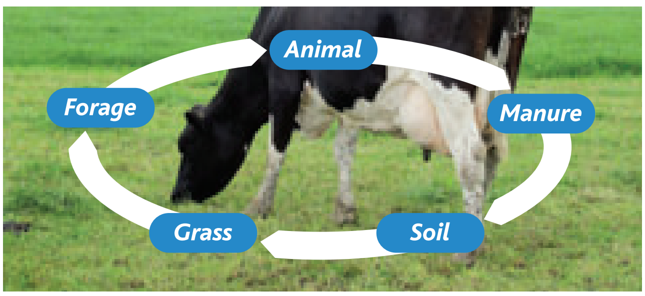
It is important to assess forage stocks for the winter to ensure a balanced feeding programme through to turnout, without incurring large swings in ingredients which may cause loss of performance and dietary upsets.

There are many options for growing different feeds on-farm (see Table 6). It is worth considering not only the feeds currently fed, but also what could be produced at home to reduce costs and improve overall feeding efficiency.

Bought-in feeds

Most systems of milk and meat production require buying-in feeds to meet all the nutrient requirements of production. These tend to be higher in energy and/or protein content than forages (see Table 7).

Think about feed nutrients in the whole system. Nutrients, particularly N and P, that cycle in the biology of production systems go from feed to animal, to soil to grass and forage crops, and back to animals.



As grass and forage drives production and profitability, the more efficiently these recycled nutrients are used, the more efficient the feeding.

Nutrient and feed management plans are intrinsically linked. The more the N, P, K and S from the soil and manures can be used, with any deficit in crop requirement met with inorganic fertiliser sources, the more the energy and protein from home-grown grass and forage can contribute.

However this can only be done if the nutrients in the soils, grass, crops and feeds are measured and known. This then allows a targeted approach to buying-in only that which is truly needed for optimum grass/crop growth and feeding.

Table 6: Typical nutrient content of some home-grown forages and feeds

Feed	*Dry Matter (%)*	*ME (MJ/kg DM)*	*CP (g/kg DM)*
Grazed grass (good quality)	18	12.0	220
Grazed grass (average quality)	20	10.5	180
Grass silage	25	11.2	140
Forage maize	30	11.2	90
Crimped maize	70	14.0	100
Maize grain	86	14.0	100
Wheat	86	13.6	100
Crimped wheat	70	13.6	100
Cereal wholecrop	30	11.0	100
Barley	86	13.2	120
Peas	85	12.8	240
Beans	85	13.3	290
Potatoes	21	13.3	90
Hay	85	8.8	90
Wheat straw	85	5.0	40
Fodder beet	18	12.0	60
Kale	14	12.0	170
Stubble turnips	8	12.0	120
Swedes	11	13.0	90

Table 7: Typical nutrient content of some bought-in forages and feeds

Feed	*Dry Matter (%)*	*ME (MJ/kg DM)*	*CP (g/kg DM)*
Sugar beet pulp	89	12.5	100
Citrus pulp	88	12.6	70
Cane molasses	75	12.7	40
Maize distillers	89	14.0	310
Maize gluten	88	12.9	220
Wheat distillers	89	13.5	280
Biscuit meal	90	15.0	130
Rapeseed meal	90	12.0	400
Hipro soya	89	13.8	560
Brazilian soya	89	13.4	500
Trafford Gold	44	13.6	200
Brewers' grains	28	11.4	250

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Feeding ruminants

At the whole farm level, consider the quantity of energy and protein the animals need to achieve the production targets set, and identify the gaps between this and what is grown on-farm.

The key to success is then attention to detail in:

- Grass and forage production
- Feed selection and purchase
- Feed utilisation

Systems for dairy cows

Whether the system operates as a paddock-grazing/minimal input system, or a total-housed/high-milk-per-cow system, or somewhere in between, profitability is based in maximising intake from home-grown grass and forage, and achieving the best feed conversion efficiency possible.

DairyCo analysed its Milkbench+ data on dairy farm systems and published figures that are useful as benchmarks for different ways of producing milk.

It showed that the range of performance within different systems of producing milk was so great that increased uptake of best management practices would significantly improve productivity. Improving the performance of the bottom 25% of producers up to the average would result in a 7% increase in milk production. Bringing the efficiency on all farms up to the top performers would result in a 35% increase in production.

The best farms achieved optimal DM intakes by feeding an optimal balanced diet.

When it comes to priorities in terms of feed planning:

- All systems require focus and attention to detail on forage production – grazed grass for cows at grass; silage and forage for high output cows
- All systems tend to have a higher margin if they increase home-grown DM intake per cow and produce more milk from home-grown feed. They buy in concentrates wisely to fill the deficits in grass and forage supply and quality

- All systems of feeding and management are capable of achieving successful results

Simple nutrient guidelines for high yielding cows in early lactation are shown below:

Table 8: The nutrient requirements of high yielding dairy cows in early lactation

Energy density MJ/kg DM	12–13
Crude Protein % DM	17–18
Sugars + Starch %	20–25
NDF %	32–34

Measure

- Routinely body condition score
- Record milk yield and quality
- Record DM output both as grazed grass and conserved forage
- Use blood profiling to monitor adequacy of rations

Rule of thumb

- Whatever the system, the biggest single cost is feed and forage. Typically around 25% for grazing-based systems, up to 35% for high output systems
- Factors affecting performance include:
  - Low body condition score in late summer reflecting poor grazing and cows drawing on dietary energy replenishing body reserves
  - Inadequate energy intake as a result of low forage quality and insufficient concentrate feeding
  - Imbalances of rumen energy and protein supply, usually with an excess of rumen degradable protein, which uses energy to get rid of it
  - As milk yield increases there is increased demand for undegradable protein

For rearing heifers

Rearing heifers to calve at 24 months compared to two and a half or three years, results in increased lifetime yield and reduced requirements for land and feed. This requires a controlled feeding and management plan to ensure the heifers are grown well enough to calve at 24 months of age.

Silage quality during the winter has significant effects on the achievement of target weights during winter, as has the quality and availability of grass during the grazing period.

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Measure

- Liveweight of heifers at turnout, housing, and at routine dosing for parasites
- Take regular height and girth measurements
- Modify feed rates to correct over/under feeding protein and energy

Rule of thumb

- Mate at 340–370kg at 13–14 months of age
- Calve at 540–570kg at 24 months at body condition score 2.5–3

Challenge

- Poor quality grazing in summer will require supplementation
- Do not neglect parasite control

Systems for beef cattle

Suckler herds

The cycle of suckler beef production is best achieved by managing distinct herds of spring or autumn calvers.

For spring calvers, the key to efficient feeding is managing grazed grass. This can provide all the energy and protein, provided calves are weaned at around six months of age to protect cow body condition for later use, when feed is less available and more expensive.

For autumn calvers, the key is providing quality home-grown forage for early lactation and good grazing for mid and late lactation. However, avoiding cows putting on excess condition from spring grass is critical, so controlling feed supply and/or weaning calves at ten months of age should be considered.

Growing and finishing systems

Growing and finishing beef cattle are distinct phases of production that require specific feeding to achieve feed efficiency and profit. Balancing resources, particularly for growing cattle, in terms of animals, infrastructure and labour is critical to running a successful system.

During the growing phase the objective is to grow frame and muscle. High levels of starch are not recommended in this period as it can lead to unwanted fat deposition.

In the final finishing period to meet carcase quality requirements, rapid liveweight gain requires feeding high energy cereal-based feeds. High starch levels can promote fast weight gains and more efficient feed conversion.

The aim of an 18-month beef system using autumn born calves is to maximise performance from grazed grass to reach market weight of 550kg at 18–20 months of age. Target growth rates of 0.8–0.9kg/day in the first winter allows animals to make compensatory growth of 1kg/day during summer at grass, followed by 1kg/day from housing to slaughter.

Grazing management has a key role in achieving target growth rates. High stocking rate can be achieved in spring, but needs to be reduced in later summer as grass availability and digestibility declines.

Good quality silage fed ad-lib supplemented with 2–4kg of 16% CP concentrates will permit targets to be reached in the first winter. Mineralised rolled barley can be used to finish animals in the second winter. Animals likely to fail to be marketed by spring, should undergo a store period and be finished off grass.

Measure

Recording cattle performance makes it much easier to manage a system. Successful cattle enterprises require the farmer to measure and monitor:

- Grass and forage production and utilisation
- DM intakes
- Concentrate and other feed inputs
- Characteristics of the diet
- Milk yields and/or liveweight gains

Challenge

Can feed conversion efficiency and profitability be improved by:

- Increasing DM intakes
- Reducing wastage in grass and forage production, utilisation, and supplementary feeding
- Reducing feed cost per kg liveweight gain?

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Systems for sheep

The most profitable sheep systems maximise output per ewe and manage feeding costs to optimise the amount of meat sold.

Sheep are particularly sensitive to nutrition at critical times during the production cycle which determine fertility, lambing success and lactation.

The system has to be geared to delivering the right nutrition at these key times. Monitoring progress through body condition scoring and ultrasound scanning for litter size is essential.

These simple measurement tools give good guidance on how to:

- Set ewes up for tupping. Increasing the condition score of lowland ewes can increase scanning % by 20–40%
- Feed appropriate diets in mid and late lactation for ewes with different litter sizes. In mid pregnancy mature pasture or sward heights of 4cm are adequate to maintain the body condition of ewes
- Ensure ewes have enough energy and protein (including DUP) to produce enough milk for singles and twins
- Make sure weaned lambs grow at the required rate to hit slaughter targets

There are many different sheep systems, from extensive hill and upland situations to higher input lowland situations. The key to managing nutrition successfully is providing the energy and protein mainly from home-grown grass and forage, to minimise the amount of bought-in feeds required. Taking this approach to balancing the nutrition of the system will improve efficiency and reduce any impact on the environment.

Rules of thumb

- Have the base forages (grass, hay, silage, straw) analysed for nutritional content. This will indicate what type and how much home-mix or bought-in compound is needed
- Raising the condition score of a lowland ewe from 2.5 at weaning to 3.5 at mating is equivalent to 1kg of concentrate, or 1kg extra high quality grass per day for ten weeks
- Do not feed more than 0.5kg of compound per feed
- Home-mixes using cereals, pulses and sugar beet pulp have a high feeding value
- Target 16–18% CP for mixes, ensuring a balance of ERDP and DUP, and an energy density of at least 12.5MJ ME/kg DM
- Thin ewes carrying twins can be fed as if carrying triplets. Fat ewes carrying twins can be fed as if carrying singles. Always monitor body condition score
- Flat rate feeding can be successful and avoids feeding very high levels of concentrate close to lambing. However there may be a wider range in performance compared to feeding individuals more specifically to need
- Feed ewe lambs that will be lambing for the first time at 12–14 months separately from mature ewes
- Well-managed grazing can provide enough energy for flushing, lactation and lamb finishing. However, supplementation with a balanced RDP/DUP protein source and energy provides a buffer against variable grazing conditions at critical times
- The type of grazing affects the potential growth rate of lambs with growth rates of 120-150g/day on well managed grassland, 200g/day on high sugar grass leys, and 225g/day on white clover swards
- Monitoring body condition of grazing ewes is a good way of determining whether their nutritional requirements are being met. Poor body condition indicates that supplementation is advised

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Whole-farm feed planning

Balancing energy demand and supply

Work through the next few pages to work out the energy balance on the farm. There are two benefits of doing this.

- Thinking through the process shows how all the demand and supply elements of feeding animals on the farm fit together
- Knowing how much energy the current system requires, and how much the farm supplies from home-grown feeds and forages, will highlight opportunities for:
  - Improving efficiency by reducing waste
  - Improving grass and forage utilisation
  - Altering production system to suit more closely current circumstances

The calculation process detailed is only approximate, so proceed with interest, but with caution. Take professional and independent nutritional advice before making significant changes to the feeding system.

Step 1:

Work out the animals' annual demand for energy

To keep it simple, look at the energy needed for a year – the annual energy requirement. The following information is needed to work out the numbers to enter on the balance sheets on pages 12–17.

Annual energy requirements for dairy stock

Table 9: Maintenance energy for cows (per cow)

Cow weight (kg)	*Annual maintenance energy requirement (MJ ME)*
550	25,550
600	27,350
650	29,200

Table 10: Energy required for milk production (per cow)

Annual milk yield (litres)	*Annual energy required (MJ ME)*
4,500	23,850
5,000	26,500
5,500	29,150
6,000	31,800
6,500	34,450
7,000	37,100
7,500	39,750
8,000	42,400
8,500	45,050
9,000	47,700
9,500	50,350
10,000	53,000

Note: milk with very high or very low butterfat content will increase/decrease energy requirements.

Table 11: Rearing dairy heifers

Year of rearing	*Rearing system – Energy to calve at...*	
	24 months (MJ ME per heifer)	*36 months (MJ ME per heifer)*
1st year	13,500	11,250
2nd year	29,400	17,750
3rd year		24,100

Annual energy requirements for beef stock

Table 12: Energy for suckler cows

Cow weight (kg)	*Annual energy requirement (MJ ME per cow)*
450	26,400
500	29,650
575	31,650
650	37,000

Table 13: Growing and finishing heifers and steers

Stock	*Annual energy requirement (MJ ME per animal)*		
	12 month system	*18 month system*	
		1st year	*2nd year*
Small heifer	22,800	10,300	16,300
Medium heifer/small steer	25,600	11,400	17,500
Large heifer/medium steer	25,800	13,600	18,700
Large steer	28,300	14,500	19,200

Table 14: Growing and finishing bulls

Breed size	*Annual energy requirement on a 12 month system (MJ ME per bull)*
Small	22,200
Medium	27,000
Large	29,800

Annual energy requirements for sheep and lambs

Table 15: Energy requirements for ewes and lambs

	(MJ ME per animal)	
Type of stock	*With singles*	*With twins*
40 kg ewe	3,450	3,600
50 kg ewe	4,050	4,350
60 kg ewe	4,600	5,150
80 kg ewe	6,100	6,650
Growing finishing lambs	1,250 per lamb	
Ewe replacements	1st year – 2,600	2nd year – 3,200
100kg ewe	7,650	8,300

Step 2:
Work out the energy supplied by feed each year

Now calculate the energy supply from the farm. Work out how much grass and forage DM is produced each year and its energy content. If these figures are not known, they can be worked out roughly.

Much of the information needed is contained in the analysis of bought-in feeds and forages that have been sampled.

It is best to make these calculations on DM value – this keeps everything on the same basis and means the energy needed and supplied can be compared.

Convert any freshweight figures into DM before starting.

Step 2a:
Work out the energy supplied from grazed grass

Unless a platemeter is used to monitor grass growth and utilisation, it is difficult to estimate the energy supplied into the system from grazed grass. Yet this is a significant and cheap source.

Rules of thumb for energy from grazed grass

Close control

13t DM/ha

- 250kg N/ha from inorganic fertiliser (or clover-rich swards)
- Grazing system controlled using a platemeter – hitting 1500kg grass DM/ha as a residual target regularly
- Utilising 90% of this and maintaining a grass ME content through the season of around 12 MJ ME/kg DM
  Assume 140,400 MJ grass energy used per ha

Moderate control

11t DM/ha

- 150–250kg N/ha from inorganic fertiliser (or clover-rich swards)
- Grazing controlled but no measurements taken
- Utilising 75% of this and maintaining a grass ME content through the season of around 11 MJ ME/kg DM
  Assume 90,750 MJ grass energy used per ha

Lax control

8t DM/ha

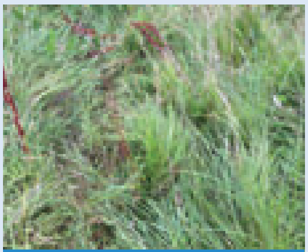
- Some inorganic N applied to grazed grass (or some clover content)
- Grazing not controlled
- Utilising 55% of this and maintaining a grass ME content through the season of around 10.5 MJ ME/kg DM
  Assume 46,200 MJ grass energy used per ha

Low input grazing with good control

10t DM/ha

- Minimal inorganic N input and clover
- Keep on top of grazing through the season
- Utilising 75% of this and maintaining a grass ME content through the season of around 10.5 MJ ME/kg DM
  Assume 78,750 MJ grass energy used per ha

Low input grazing with lax control and rough grazing



8.5t DM/ha

- Minimal inorganic N input and clover
- Non-productive species in the sward
- No grazing control
- Utilising 55% of this and maintaining a grass ME content through the season of around 9.5 MJ ME/kg DM
  Assume 44,400 MJ grass energy used per ha

Do not forget that there may be multiple types of grazing sward on the farm, so take this into account when calculating annual grazed grass yield.

Step 2b:

Work out the energy supplied by conserved forages

The energy per ha used from grass, wholecrop and maize silages depends on:

- How much is grown
- Crop quality
- How well it is preserved
- How much is wasted at feeding out

If conserved forages are sampled and tested the feed analysis will indicate their DM and energy contents. These can be used to work out how much energy is being produced and used from these silages. Subtract any wastage in storage and feeding out from the total produced.

Typical clamp losses range from 10–15% of the DM, but can be as high as 30% in poorly managed feeding systems

If these analysis figures are not available, use the information in Table 16 to estimate energy utilisation from forages.

It is not possible to show every scenario of quality, level of inputs and utilisation, but the ranges shown can act as a rough guide.

Table 16: Typical energy utilisation per ha from different forage systems

Forage		*DM yield/ha*	*% utilised*	*MJ ME used/ha*
Grass – high quality/input/utilisation				
(11.5MJ ME/kg DM)	3 cuts	14	80	128,800
	2 cuts	10	80	92,000
	1 cut	6	80	55,200
Grass – moderate quality/input/utilisation				
(10.8MJ ME/kg DM)	3 cuts	12	70	90,720
	2 cuts	8	70	60,480
	1 cut	5	70	37,800
Grass – low quality/input/utilisation				
(10.0MJ ME/kg DM)	3 cuts	11	60	66,000
	2 cuts	7	60	42,000
	1 cut	4	60	24,000
Wholecrop – high quality/input/utilisation				
(11.0MJ ME/kg DM)		14	85	130,900
Wholecrop – low quality/input/utilisation				
(9.8MJ ME/kg DM)		10	65	63,700
Forage maize – high quality/input/utilisation				
(11.5MJ ME/kg DM)		16	85	156,400
Forage maize – low quality/input/utilisation				
(11.5MJ ME/kg DM)		12	65	81,900

The quantity and quality of conserved forages will change between fields in any year – not all fields are the same, and they will change between years. Every season is different. If historical data is not available, make a best estimate of what is usually achieved. Also, seriously consider measuring yield, quality and utilisation in future. Measuring is a useful management tool that can generate ideas for improvement.

Remember to make some allowance for aftermath grazing in the calculations at around 2–3t DM/ha at 10.5MJ ME/kg DM.

Alternatively, the ME contribution from forages can be determined from measuring the density of the silage, and working out the quantity fed from the dimensions of the clamp, and the analysed energy content of the silage.

Step 2c:

Work out the energy supplied by concentrates and straight feeds

This is the relatively easy part! The amount bought in is known and the ingredients label gives information on energy density on a DM basis. A few typical values are given in Table 17.

Table 17: Typical energy used in concentrates

Feed	*Dry Matter (%)*	*ME (MJ/kg DM)*	*MJ ME in 10 tonnes DM*
Compound concentrate	85	12.5	106,250
Sugar beet pulp	89	12.5	111,250
Citrus pulp	88	12.6	110,880
Cane molasses	75	12.7	95,250
Maize distillers	89	14.0	124,600
Maize gluten	88	12.9	113,520
Wheat distillers	89	13.5	120.150
Biscuit meal	90	15.0	135,000
Rapeseed meal	90	12.0	108,000
Hipro soya	89	13.8	122,820
Brazilian soya	89	13.4	119,260
Trafford Gold	44	13.6	59,840
Pressed pulp	25	12.0	30,000
Brewers' grains	28	11.4	31,920

Step 3:

Subtract the total energy demand from the total energy supply to find the whole farm annual energy balance.

Use the worksheets on pages 12–17 to work this out quickly and easily.

Balance sheets for dairy

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Fill in the gaps in white panels with real figures to find out whether not enough or too much energy is produced/supplied to the livestock. Handwritten examples are shown in tinted panels.

Annual energy demand

Livestock	***Milk yield*** *(litres/year)*	***A*** *Number*	***B*** *Energy requirement (MJ ME/yr/head) From Tables 9–12 or own figures*	***A x B*** *Energy requirement (MJ ME/yr)*
Mature cows (600 kg)	7,500	120	68,950 (29,200 maintenance + 39,750 for milk yield)	8,274,000
Mature cows				
1st calved heifers (550kg)	6,500	30	54,600 (20,150 maintenance + 34,450 for milk yield)	1,638,000
1st calved heifers				
Replacement heifers – 1st year		35	13,500	472,500
Replacement heifers – 1st year				
Replacement heifers – 2nd year		35	29,400	1,029,000
Replacement heifers – 2nd year				
Total energy requirement for farm (MJ ME)				**10,608,900**
Total energy requirement for farm (MJ ME)				

Annual energy supply

Input	***A*** *Grass and forage ha*	***B*** *Utilised MJ ME/ha From Table 17 or own figures*	***C*** *Feed MJ ME/kg DM From Table 18 or own figures*	***D*** *Tonnes feed dry matter used*	***A x B*** *Grass and forage energy supplied*	***C x D*** *Bought-in feed energy supplied*
Grass and forage						
Grazing (moderate control)	15	90,750			1,361,250	
Grazing						
2nd cut silage (moderate quality)	20	60,480			1,209,600	
Grass silage						
Grass silage						
Grass silage						

Aftermath grazing (3t DM/ha at 10.5 MJ ME/kg DM)	20	31,500			630,000	
Aftermath grazing						
Forage maize (high quality)	15	156,400			2,346,000	
Forage maize						
Wholecrop (high quality)	10	130,900			1,309,000	
Wholecrop						
Other forages						
Other forages						
Total grass and forage energy supply (MJ ME)					**6,855,850**	
Total grass and forage energy supply (MJ ME)						
Bought-in feeds						
Compound concentrate			12.5	190		2,375,000
Sugar beet pulp			12.5	100		1,250,000
Brazilian soya			13.4	55		737,000
List bought feeds in rows below						
Total bought-in feed energy supply (MJ ME)						**4,362,000**
Total farm energy supply (MJ ME)						**11,217,850**
Total bought-in feed energy supply (MJ ME)						
Total farm energy supply (MJ ME)						

Example annual farm energy balance (MJ ME)

Supply	*minus*	*Demand*	*Balance*	*+ or -*
11,217,850	–	10,608,900	608,950	+

This means the example farm produces/supplies more energy to its animals than they need for maintenance and production.

Farm results

Supply	*minus*	*Demand*	*Balance*	*+ or -*
	–			

Balance sheets for beef

Fill in the gaps in white panels with real figures to find out whether not enough or too much energy is produced/supplied to the livestock. Handwritten examples are shown in tinted panels.

Annual energy demand

Livestock	***A*** *Number*	***B*** *Energy requirement (MJ ME/yr) From Tables 13–15 or own figures*	***A x B*** *Energy requirement (MJ ME/yr)*
Suckler cows (500 kg)	100	29,650	2,965,000
Suckler cows			
In-calf heifers (450kg)	20	26,650	533,000
In-calf heifers			
Growing/finishing cattle 1st year	40	13,600	544,000
Growing/finishing cattle 1st year			
Growing/finishing cattle 2nd year	40	18,700	748,000
Growing/finishing cattle 2nd year			
Total energy requirement for farm (MJ ME)			**4,790,000**
Total energy requirement for farm (MJ ME)			

Annual energy supply

Input	***A*** *Grass and forage ha*	***B*** *Utilised MJ ME/ha From Table 17 or own figures*	***C*** *Feed MJ ME/kg DM From Table 18 or own figures*	***D*** *Tonnes feed dry matter used*	***A x B*** *Grass and forage energy supplied*	***C x D*** *Bought-in feed energy supplied*
Grass and forage						
Grazing (lax control)	30	46,200			1,386,000	
Grazing						
Rough grazing	5	44,400			222,000	
Other grazing						
Two cut silage (moderate quality)	20	60,480			1,209,600	
One cut silage (low quality)	10	24,000			240,000	
Grass silage						
Grass silage						
Grass silage						

Aftermath grazing (2t DM/ha at 10.0 MJ ME/kg DM)	30	20,000			600,000	
Aftermath grazing						
Wholecrop silage (low quality)	10	63,700			637,700	
Other conserved forage						
Other conserved forage						
Total grass and forage energy supply (MJ ME)					**4,295,300**	
Total grass and forage energy supply (MJ ME)						

Bought-in feeds

Straw			6.0	23		138,000
Rapeseed Meal			12.0	50		600,000
List bought feeds in rows below						
Total bought-in feed energy supply (MJ ME)						**738,000**
Total farm energy supply (MJ ME)						**5,033,300**
Total bought-in feed energy supply (MJ ME)						
Total farm energy supply (MJ ME)						

Example annual farm energy balance (MJ ME)

Supply	*minus*	*Demand*	*Balance*	*+ or -*
5,033,300	–	4,790,000	243,300	+

This means the example farm produces/supplies more energy to its animals than they need for maintenance and production.

Farm results

Supply	*minus*	*Demand*	*Balance*	*+ or -*
	–			

Balance sheets for sheep

Fill in the gaps in white panels with real figures to find out whether not enough or too much energy is produced/supplied to the livestock. Handwritten examples are shown in tinted panels.

Annual energy demand

Livestock	*A* Number	*B* Energy requirement (MJ ME/yr) From Table 16 or own figures	*A x B* Energy requirement (MJ ME/yr)
Ewes with twins (60kg)	250	5,150	1,287,500
Ewes with twins			
Ewes with singles (60kg)	100	4,600	460,000
Ewes with singles			
Growing/finishing lambs	530	1,250	662,500
Growing/finishing lambs			
Ewe replacements – 1st year	70	2,600	182,000
Ewe replacements – 1st year			
Ewe replacements – 2nd year	70	3,200	224,000
Ewe replacements – 2nd year			
Total energy requirement for farm (MJ ME)			**2,816,000**
Total energy requirement for farm (MJ ME)			

Annual energy supply

Input	*A* Grass and forage ha	*B* Utilised MJ ME/ha From Table 17 or own figures	*C* Feed MJ ME/kg DM From Table 18 or own figures	*D* Tonnes feed dry matter used	*A x B* Grass and forage energy supplied	*C x D* Bought-in feed energy supplied
Grass and forage						
Grazing (good control)	20	78,750			1,575,000	
Grazing						
Rough grazing	5	44,400			222,000	
Other grazing						
Two cut silage (moderate quality)	10	60,480			604,480	
One cut silage (low quality)	10	24,000			240,000	
Grass silage						

Grass silage						
Grass silage						
Aftermath grazing (2t DM/ha at 10.0 MJ ME/kg DM)	20	20,000			400,000	
Aftermath grazing						
Wholecrop silage						
Other conserved forage						
Other conserved forage						
Total grass and forage energy supply (MJ ME)					3,041,480	
Total grass and forage energy supply (MJ ME)						
Bought-in feeds						
Sheep feeds			12.0	10		120,000
List bought feeds in rows below						
Total bought-in feed energy supply (MJ ME)						120,000
Total farm energy supply (MJ ME)						3,161,480
Total bought-in feed energy supply (MJ ME)						
Total farm energy supply (MJ ME)						

Example annual farm energy balance (MJ ME)

Supply	*minus*	*Demand*	*Balance*	*+ or -*
3,161,480	–	2,816,000	345,480	+

This means the example farm produces/supplies more energy to its animals than they need for maintenance and production.

Farm results

Supply	*minus*	*Demand*	*Balance*	*+ or -*
	–			

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Think about farm energy balance

Once an annual whole-farm energy balance has been calculated, it is time to analyse and act on the results.

Bear in mind these are approximate figures, especially if standard industry data was used rather than the farm's own figures.

Negative balance

If the results indicated that the feed supplied is not meeting animal production requirements consider these options.

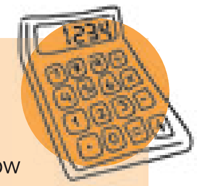
- Are there any general issues with animal health and productivity? Is illness holding back growth rates leading to an inefficient use of feed?
- Is the farm over-stocked?
- How can the shortfall be made up? Supplying home-grown energy is generally more cost-effective than buying it in

Positive balance

Supplying more energy in the feed than the animals really need is a waste of resources including money and labour.

- Could more stock use the excess energy? What consequences might this have on protein supply
- Could surplus home-grown energy reduce the amount of feeds needed to be purchased?

Do not forget that every system has to have enough metabolisable protein input (in particular DUP protein for high yielding dairy cows), balanced and matched to energy input, to meet the requirements of production. Explore this with a registered feed adviser or nutritionist to get the most out of the farm feeding plan.



Measure

Taking measurements at every stage of the feeding process makes it easier to pinpoint how to improve efficiency and reduce costs.

For example:

- Measuring silage yields from each field at each cut, and matching these to silage analysis will give a better idea of where the energy is coming from in conserved forages
- Having a few grass samples analysed during the grazing season will allow steps to be taken to improve quality and quantity of future grazed grass intakes

Challenge

Can feed conversion efficiency and profitability be improved?

- Can more energy be grown on-farm so more stock can be carried?
- What measurements can be taken to help get a better understanding of the sources of energy in the system?
- What actions can be taken to derive more from home-grown energy on the farm?

Muriel Callan

The benefits of following the Tried & Tested feed plan

Arable and sucker beef producer Stephen Hobbs explains what he discovered when he followed the new Tried & Tested publication *'Feed planning for cattle and sheep'*.

Feeding approach

This new booklet takes a bottom up approach to feed planning. It has made me look first at what my cattle need to eat to be productive, then how much of this I can produce on farm, before topping up with bought-in feeds.

Production from grass and forage

The first thing I looked at was the quality of the grassland, to assess how much production I can achieve from it.

While I was in the field, I asked myself whether the pastures are up to producing enough silage of the right quality to feed my cattle efficiently.

Energy in and energy out

Back in the office, the first step in the process is to work out the amount of energy the livestock need to eat to maintain themselves and perform to the levels expected.

For this, I worked out the ME requirements for each of the different age groups on the farm using the tables in the guide. This told me the total amount of energy I need. Then I worked out the energy I am providing in the home-grown and bought-in feeds.

After working through the energy balance sheet for beef, I found I have a positive balance to my feed energy profile. This means I could either buy in less feed or increase my stock numbers.

Feed efficiently

To find out the efficiency of the diets fed, I divided the total energy that the cattle eat, by the amount of beef they produce. I can increase the profitability of the farm by improving feeding efficiency.

Care for the environment

Nutrients come onto the farm in feed – as well as in fertilisers and manures applied to the grass. More efficient use of nutrients in feed can save me money, and reduce losses to the atmosphere and water.

Monitoring

Now my new feed plan is in place I need to make sure we are achieving the targets set. I can do this by monitoring the daily liveweight gain of the young cattle by putting them through a weigh-crate. I can gauge the performance of the suckler cows by monitoring their body condition score, and altering the ration if they get too fat or too thin.

Summing up

Following the Tried & Tested feed plan helps me with my integrated farm management, and allows me to take a whole-farm approach to running my farm.

Tried & Tested has provided another useful manual in its series of booklets. These help farmers with their nutrient, feeding and manure management.

This latest publication fits nicely between the 'Tried & Tested Nutrient Plan' and 'Think Manures' – it really is the meat in the sandwich.

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Nutrition and animal health

Animal health is critical to performance and business success; unhealthy animals will not generate efficient production or profits.

However, this is a 'cart-and-horse' issue. Animals can only be healthy if all their nutritional needs are being met, yet livestock will only make optimum use of their feed if they are healthy.

The key is to tackle both at the same time, making sure nutrition and feeding are correct for the type of animal and its stage of production, and by preventing ill-health in the first place. Any unhealthy animals should be dealt with quickly and effectively.

Unhealthy animals cost money

It is difficult to deduce an accurate cost of treating disease, because so many interrelated factors are involved, such as reduced feed intake, reduced milk yields, treatment costs, extra labour spent dealing with sick animals, less labour spent on forward planning, etc.

However some industry standards serve to demonstrate the issue (see Table 18). These do not account for the cost of culling, replacement rates and associated replacement costs.

Table 18: Typical costs associated with unhealthy cows

Condition	*Typical cost of treatment per case*
Lameness (score 2)	£75–£100
Metritis	£100–£150
Lameness (score 3 – severe)	£150–£300
Milk fever	£200–£250
SARA (Sub-Acute Ruminal Acidosis)	£200–£300
Retained cleansing	£250–£300
Mastitis	£250–£350
LDA (displaced abomasum)	£450–£550

The role of nutrition in health

The farm's feeding plan has a fundamental influence on animal health, and therefore productivity.

The main issues to consider are:

Energy and protein

Getting enough energy and protein into livestock is one thing; getting the right balance of energy and protein sources is another.

Do… make sure there is the right balance of energy (fibre, sugar, starch) and protein (ERDP and DUP) in the diet for each group of animals, according to their needs at each stage of production.

Don't… push cost reduction to the extent that energy and protein balance, and therefore animal health, is compromised. Most modern breeds of stock require some additional, usually bought-in supplementary sources of energy and protein to meet their requirements.

Minerals

This publication has dealt mostly with system energy requirements, with some consideration of protein. However, minerals such as Ca, Mg and P are essential for milk and meat production.

Forages contain a wide range of minerals. It is strongly recommended that a mineral analysis is carried out on home-produced forages to ensure a balanced intake of the major and minor elements.

Balanced mineral and vitamin supplements for various livestock systems are widely available from a range of technically proficient supplement suppliers, with recommended feeding rates.

Do… provide sufficient Ca in concentrates, licks and water in late pregnancy and early lactation to avoid hypocalcaemia.

… provide sufficient Mg in concentrates, licks and water during peak lactation and in spring and autumn to avoid hypomagnesaemia (grass staggers) in dairy cows and suckler cows, and to ewes when lambs are turned out in spring.

… pay special attention to lower input systems, eg cows at grass, where there is less opportunity to feed minerals in concentrates.

Don't… leave mineral nutrition to chance. If in doubt take independent advice.

Animals often become stressed during periods of transition, eg at turnout, at housing, moving from the dry cow to milking herd. Stress increases the likelihood of animals falling ill with mineral deficiencies.

Trace elements/micronutrients

Copper, selenium, cobalt, zinc, iron (Fe) and iodine (I) are all critical for good animal health. These trace elements, or micro-nutrients, are only required in small quantities. However, if they are deficient in the diet the immune function in ruminants will be compromised, with animals becoming more susceptible to disease. For example, fertility will drop if trace elements are not sufficient in the diet, and there are associations with deficiency and mastitis and lameness.

Note that Cu can also be toxic, with an increase in reports from vets of cases of toxicity in recent years. In soils prevalent in the grassland areas of the west of the UK, a deficiency in one of Cu, Co or Se is usually associated with a deficiency in the other two.

Do... provide sufficient trace elements in the diet by using additions to concentrate supplements and/or dosing animals using other means, eg boluses.

... treat trace element deficiencies together, providing treatment for multiple elements.

... make sure that stock has enough trace element input during times of high production, such as during late pregnancy, early lactation, rapid growth.

... take special care in low input systems where there is less chance of getting trace elements into animals through supplementary concentrates.

... take independent advice on trace elements if there are any concerns.

Don't... ignore trace element nutrition in the diets of ruminants.

... wait until there is a problem. If in doubt, ask the vet to take blood samples from a portion of the stock at a time of high production and assess for deficiencies.

... rely on soil and grass/forage samples and analysis for trace elements as these can throw up false results. It is best to test for deficiencies in the animals and use soil/herbage analysis to inform decisions to act.

Spot the warning signs

It is possible to pick up warning signs when nutrition is not quite right, and may be having a detrimental impact on animal health.

- Increased cases of milk fever and staggers will highlight problems with the major minerals
- General low immunity, ill-health and a failure to reach production targets may indicate problems with trace elements
- Loose dung with dirty hindquarters can be a sign of acidosis and a diet that is damaging the rumen lining
- Animals that fail to thrive might not be getting access to feed because of bullying and/or lack of feed space. Make sure all animals can gain feed at the same time comfortably

Rule of thumb

- Cows and ewes with mastitis, metritis, digestive upsets and lameness have a reduced DM intake, which reduces fertility, and milk and meat production
- Animals that have an inadequate diet are more prone to disease because their immune function is reduced
- Water is the base of all life – an inadequate and/or unclean supply will reduce animal health, regardless of feeding skill and animal health treatment

Challenge

Think about nutrition when reviewing animal health.

- Is the stock having sufficient minerals and trace elements?
- Record cases of ill-health and review records regularly to pick up trends that might be related to nutrition
- Make sure nutrition is part of the farm animal health plan

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Protecting the environment by feed planning

The main concerns regarding animal nutrition and the environment are nitrous oxide, methane (GHGs) and ammonia emissions to the air, and losses of nitrate, nitrite, ammonia and phosphate to water.

Where levels exceed water quality standards, costly treatment or blending is required.

Nutrients also impact on aquatic life and in the most damaging cases cause algal blooms.

Sewage treatment and rural septic tank leakage also lead to loss of nutrients to water courses.

Agriculture also has to play its part in cleaning up streams, rivers, lakes and ground waters. Farmers are already taking major actions to abide by the rules of Nitrate Vulnerable Zones (NVZ) under cross compliance. They will have to do more to reduce N and P loss in specific catchments to meet the water quality objectives of the Water Framework Directive (WFD).

However, there are some simple things that can, and should be done outside these regulations to ensure least harm to the farmed environment.

Emissions of GHGs and ammonia from farming are in the spotlight – agriculture accounts for 7% of the UK's GHG losses and around 80% of the ammonia emissions. There are legal obligations for the UK to make its share of the contributions to emissions reduction, through farmers adopting good practice such as nutrient, feed and health planning.

As methane is an unavoidable by-product of rumination, cattle and sheep farming will always have some impact. However, there are things that can be done to mitigate the problems.

N and P in livestock feeds

The N and P inputs to a farm are not just from inorganic fertilisers. Nitrogen and P are also imported onto the farm in every tonne of feed, see Table 19.

The problem is that ruminants do not use N and P very efficiently. For example, for every 100kg of N fed to stock, only about 15–30kg are retained in the animals and available to export as milk and meat. The other 70–85kg enter the N cycle where it follows various paths. It can end up lost to the atmosphere as ammonia or as nitrous oxide – retained in soil after manure application, pass through soil into grass and crops, or run-off and leach (mainly as nitrate) into water.

It is the losses of N into water and the air that must be reduced to a minimum by the way the N cycle is controlled on-farm. The best way to do this is to increase efficiency of N use which will reduce surplus N in the system.

Following the Code of Good Agricultural Practice, and NVZ regulations where applicable, is a start. This helps reduce N losses and retain more N in the system. This will mean less N in inorganic fertilisers will be needed and the system will be more efficient – helping the farm's finances. It is a win:win for the environment and the bank balance.

The situation for P is similar. The P not retained in animals on the farm, or exported in milk and meat, goes mostly into the soil through manure applications to grass and crops. From there it is recycled in plant growth, retained in soil reserves, or leaves the farm in water as run-off from fields or lost in soil particles swept into water courses. The more in balance the farm is for P, the less risk there is of losing P to water and less P will have to be purchased.

Table 19: N and P imported to farms in feeds

Feed	*Crude protein (% DM)*	*N in 100 tonnes fresh weight (tonnes)*	*P (g/kg DM)*	*P in 100 tonnes fresh weight (tonnes)*
Wheat	10	1.4	3.5	0.30
Barley	12	1.7	4.0	0.34
Concentrates	12–20	1.6–2.7	3.5–5.5	0.30–0.47
Sugar beet pulp	10	1.4	2.0	0.18
Maize distillers	31	4.4	1.0	0.09
Maize gluten	22	3.1	8.6	0.76
Wheat distillers	28	4.0	2.1	0.19
Rapeseed meal	40	5.8	10.6	0.95
Hipro soya	56	8.0	7.0	0.62
Brazilian soya	50	7.1	7.0	0.62
Trafford Gold	20	1.4	9.0	0.40
Brewers' grains	25	1.1	5.0	0.14

Challenge

N and P use efficiency can be improved by:

- Buying the correct feeds for your system. This means planning to use less and not feeding more N and P than the animals need
- Having a farm nutrient management plan that targets N and P inputs to each field, according to soil fertility and grass/crop requirements
- Applying manure and fertilisers at the right time to maximise uptake by the crops and minimise losses to the environment
- Making sure that K and S inputs are sufficient so that the grass, crop and animal production processes use as much of the N and P supplied as possible
- Abiding by the Code of Good Agricultural Practice and Cross Compliance requirements, including NVZ rules to minimise the risk of losses to air and water
- Having a soil protection plan in place which is reviewed annually

Reduce GHG emissions by improving feed efficiency

A farm's feed plan can have a large impact on GHG emissions.

- Improving feed efficiency means surplus N will be reduced. This will lead to fewer losses of ammonia and nitrous oxide during manure storage and application, and field operations like reseeding and cropping
- Ensuring that standards of animal health and welfare are high will improve feed efficiency and reduce inputs. This will reduce N use and methane production per unit of milk and meat produced
- Making sure the feed plan supports target milk and meat production with optimal inputs will reduce replacement rates. This will mean there is less youngstock on farm at any one time, leading to less bought-in feed, less methane production and potentially less N in the system
- Getting the most out of home-grown energy with minimal inorganic N inputs from fertilisers, possibly using more nitrogen-fixing clovers, can help reduce GHG emissions from N fertilisers and manures

Challenge

Can GHG emissions be reduced by:

- Getting more milk and meat from home-grown energy?
- Optimising inorganic N inputs and/or using more clover?
- Improving animal health and feed intake to get more production per animal?
- Injecting or rapid incorporation of slurry?

Think

Do not forget that the feed plan, crop nutrient management plan and measures to improve soil condition are all linked. They can all impact positively on the farmed environment by reducing N, P, ammonia and GHG losses.

Publications such as Tried & Tested *'Nutrient Management Plan'* and *'Think Manures'*, and the Environment Agency's *'thinksoils'* are good places to find information on how to start the thinking and planning process.

Sources of information

Arla Foods/Morrisons Supermarkets/ The British Grassland Society

Grassland soils and fertilisers: digging out the answers

The British Grassland Society
Tel: 02476 696 600
Email: office@britishgrassland.com
www.britishgrassland.com

DairyCo

feeding+ Feeding Improvement Programme

grass+ Grassland Management Improvement Programme

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Tel: 02476 692 051
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www.dairyco.org.uk

EBLEX

Beef and Sheep BRP Manual 1 – *Improving pasture for Better Returns*

Beef and Sheep BRP Manual 4 – *Managing clover for Better Returns*

Beef and Sheep BRP Manual 5 – *Making grass silage for Better Returns*

Beef BRP Manual 5 – *Feeding suckler cows for Better Returns*

Beef BRP Manual 7 – *Feeding growing and finishing cattle for Better Returns*

Sheep BRP Manual 12 – *Improving ewe nutrition for Better Returns*

The Mini Feeds Directory

The Home-Grown Cereals Directory

EBLEX
Tel: 0870 241 8829
Email: brp@eblex.ahdb.org.uk
www.eblex.org.uk

Environment Agency

thinksoils, A manual for assessment of soil to avoid erosion and run-off

Best farming practices, What's in it for you… Profit from a good environment

Environment Agency
Tel: 08708 506 506
Email: enquiries@environment-agency.gov.uk
www.environment-agency.gov.uk

Tried & Tested

Tried & Tested New to Nutrient Management Planning

Tried & Tested Think Manures

Tried & Tested
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The group that has put this document together comprises:

- Agricultural Industries Confederation (AIC)
- Agriculture and Horticulture Development Board – DairyCo and EBLEX
- British Grassland Society (BGS)
- Catchment Sensitive Farming (CSF)
- Country Land and Business Association (CLA)
- Linking Environment and Farming (LEAF)
- National Farmers Union (NFU)

Assisting farmers to improve the efficiency of their operations by integrating the use of all nutrients within their production system is a primary objective of all these organisations. Industry co-operation is vital to achieve this goal, and publication of this guide is an essential element of the Tried & Tested initiative.

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TRIED & TESTED

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www.eblex.org.uk

Environment Agency
Email: enquiries@environment-agency.gov.uk
www.environment-agency.gov.uk/bestfarmingpractices

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www.pgro.org

RSPB
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This and all Tried & Tested tools can be requested by calling 02476 858 896 or emailing nutrientmanagement@nfu.org.uk.

Documents can also be downloaded from www.nutrientmanagement.org

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Catchment Sensitive Farming
A clear solution for farmers
England Catchment Sensitive Farming Delivery Initiative

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