# SIMPLY SUSTAINABLE WATER

## Six Simple Steps for managing water quality and use on your land

ASDA

LEAF
LINKING ENVIRONMENT AND FARMING
*Integrated Farm Management*

MOLSON Coors

The world's water resources are no longer to be taken for granted. Access to supplies has increasingly become a balance between water's use within economic activity, including agriculture's predominant role, for human health and nutrition as well as landscape and amenity value.

It is important that those who have either a large demand or highly public use of water are demonstrably doing so in a responsible manner. Farmers and growers have been custodians of water since prehistoric times. Water has been collected and retained for use in drier conditions or the vagaries of weather have led to the success or failure of crops. The current position is different. We have tools and systems that give us far greater control over water than our forebears. Yet, at the same time, the demand for water has never been greater.

We need to undertake the care and husbandry of water that this precious resource deserves. ASDA hopes that this publication is a significant assistance to meet this challenge.

**Dr Chris Brown** Head of Sustainable Sourcing, ASDA

At Molson Coors Brewing Company, we are committed to reducing water use and preserving and protecting the catchments where we operate. We have set a challenging long term goal of improving water efficiency by 20 percent, by 2020 (versus 2011).

We work continuously to reduce the environmental impact of our operations and are extending our best practices to our growers and our suppliers. We recognise that water is vital throughout our supply chain. In fact, Water Footprinting indicates that more than 98 percent of our footprint is in our supply chain.

Based upon these findings, we are delighted to formally engage with stakeholders in our catchments through programmes such as our partnership with LEAF to develop the LEAF Water Management Tool in 2010 and to work on this booklet to deliver simple, action orientated guidance, to ensure our growers and farming practices are truly sustainable and enable water for all.

**Lee Finney** European Chief Supply Officer, Molson Coors Brewing Company



Water management is a global issue; however, the solutions must happen locally. The challenge and opportunity for farmers is how to produce more food, using less water, whilst protecting its quality. In the UK we have historically taken water, and its availability, for granted, but the last five years of extreme weather patterns has started to make us increasingly more aware of the challenges and importance of its management.

On farm, water is one of the most important natural resources, whether sourced from rain, rivers or aquifers, too much or too little can cause major challenges. Sudden rainfall events can lead to loss of nutrients and crop protection products and loss of timeliness of operations, while in severe droughts, farmers can struggle to keep livestock and crops alive. Increasingly farmers will need to adapt to the 'yo-yo' effect of drought and flooding, however, putting effective long term risk management strategies into practice can be challenging.

LEAF is delighted to have developed this booklet in association with ASDA and Molson Coors Brewing Company to demonstrate our joint commitment to raising awareness and opportunities for the best of water management and protection.

Measuring progress and delivering change is at the heart of LEAF's work through the adoption of Integrated Farm Management and this booklet will help you do just that. If you make only one change on your land this year as a farmer, then make this your first step.

**Stephen Fell** Chairman, LEAF

## Credits

This booklet has been developed by LEAF in close association with ASDA and Molson Coors Brewing Company, with particular thanks to:

**Dr Louise Manning** Royal Agricultural College, Cirencester

**Robert Helliwell** and **Robert Kynaston** LEAF Demonstration Farmers

**Andy Blant** Bayer CropScience and **Julian Davies** Stockbridge Technology Centre, LEAF Innovation Centres

**The Environment Agency**

"Water is the driving force of all nature."
Leonardo da Vinci

This booklet has been produced to help you develop an effective on-farm management strategy for efficient water use and to improve the farm's contribution to protecting water in the environment. It allows you to get the best from this valuable resource, to improve awareness of the importance of water and track changes in water use and quality over time.

Based on Six Simple Steps to help improve the performance, health and long term sustainability of your land, you are encouraged to set a baseline by assessing and mapping your water use and main water sources. This should include boreholes, reservoirs, ponds, rivers, streams and other water courses.

Where possible you are encouraged to keep a photographic diary of those areas prone to flooding, drought and run-off and where you have seen change and improvement over time. By recording and mapping your farm you will build up a long term picture of how you manage and protect your water sources as an integral part of your land management.

## Six Simple Steps for managing water quality and use on your land

**Management**

1. Water Saving
2. Protecting Your Water Sources

**Physical Health**

3. Soil Management
4. Drainage

**Monitoring**

5. Tracking Your Water Use
6. Water Availability and Sunshine Hours



## Why Water?

Water is essential for all dimensions of life. We can live three weeks without food, but without water we would be dead in as little as three days. Globally, 40% of the world's population face water shortages and the quality of water in rivers and aquifers continues to deteriorate. It is predicted that by 2030, the world will need to produce 50% more food and energy, together with 30% more available fresh water, whilst still mitigating and adapting to climate change (Beddington 2011).

"Climate change is projected to increase the frequency, intensity and duration of droughts, with impacts on many sectors, in particular food, water, health and energy. We need to move away from a piecemeal, crisis-driven approach and develop integrated risk-based national drought policies." Michel Jarraud, Secretary General, World Meteorological Organisation (WMO 2012).

### 2012 - A tough year

Early in 2012, UK farmers experienced one of their worst growing seasons in living memory. After two years of lower than average winter rainfall, rivers were at their lowest levels since 1976, with a severe lack of rainfall not seen since the drought of 1921. This period was followed by record amounts of rainfall through 2012, the second highest since records began, with parts of the UK hit by freak storms, and flash flooding that forced the evacuation of homes and flooded farmland for months.

Across the Atlantic, drought in the US meant that in 2012 the annual maize harvest produced the lowest yield since 2006, despite there being the most acres of maize planted in more than 70 years. This was due to unusual triple-digit summer temperatures that disrupted pollination and a severe drought particularly in the middle of the country.

The World Meteorological Organisation (WMO) has stated that these weather extremes and its ripple effects on global food markets, especially global food prices, shows the need for policies with more water conservation and less water use. While policies are developed on a global, as well as a local scale, it is important too that farmers and land managers develop practical risk management approaches on farm.

This booklet is designed to support you in managing your water more sustainably, not only to mitigate the impact of unpredictable weather on your cropping and grazing plan but also to meet the requirements of the Water Framework Directive (WFD) to ensure that inland and coastal waters reach 'good' chemical and ecological status by 2015.

## A few water facts for the UK (Defra survey 2011)

- Mains water is by far the most common water source for farming (83% of farms) across all activities.
- The total cost of water accounts for 1% of the total fixed costs. However, this is very dependent on the enterprise mix on a specific farm.
- The total volume of water used in agriculture is 184 million $m^3$. Drinking water for livestock is the biggest form of water usage accounting for 41% of the total, followed closely by irrigation (38%).
- In 2010, the irrigated area of outdoor crops and grass decreased by 28% compared to 2005 due to a reduction in the number of irrigators and wetter weather conditions. Weather conditions in 2011 were extremely dry, 2012 reversed the trend, across most of the country, but the North West and Scotland experienced very different weather conditions.
- The most common method of irrigation is the hose reel, which was used to irrigate 93% of the total irrigated area in 2010.
- Grazing livestock farms and mixed farms are far more likely (60% and 46% respectively) to use water from rivers/streams or springs than cropping and granivore farms (grain based diets such as pigs and poultry).



# Integrated Farm Management (IFM)

There is no one single solution on farm – it is important to consider the whole farm in an integrated way.

'Integrated Farm Management (IFM) is a whole farm business approach that delivers sustainable farming.'

IFM is geared towards sustaining and optimising the use of all resources on farm, including soil, water, air, staff, machinery, capital, wildlife habitats, landscape and archaeological features, addressing regulation and embracing innovation. Its successful uptake requires a detailed understanding of the business and an innovative and challenging approach. The implementation of IFM is all about adopting knowledge and innovation alongside beneficial husbandry principles and traditional methods. It is built around your development of a risk management approach to anticipate, assess, manage and develop contingency plans for any unplanned and/or natural events.

The following Six Simple Steps for managing water quality and use on your land will enable you to understand and manage water more sustainably and help your business become more resilient to environmental change.

As you work through this booklet consider the following:

- Think water – its management, use and protection
- Score each section – on an annual basis
- Keep a photographic diary to compare changes year on year


**Figure 1:** The features of Integrated Farm Management

# Getting Started

Start off by identifying your main uses of water on the farm. These questions may help:

1. What do you use water for and what quality of water do you require for each use?
2. Do you need to use mains water or will rainwater, surface or groundwater be suitable?
3. How much water do you use?
4. How much does water cost the business and each enterprise?
5. Are there opportunities for reducing water wastage e.g. installing additional meters to record use and providing detailed information on use and leaks in different parts of the farm, recycling, preventing leaks, using triggers on water hoses, repairing leaks?
6. Are there opportunities for collecting rainwater?
7. Do you keep clean and dirty waste water separate?
8. Do you have a drainage plan for the fields and yard areas?
9. Do you know where underground piping is located and where you can isolate your water to repair leaks?
10. Have you identified pollution risks and how they can be reduced?

## What to Monitor? – Six Simple Steps for managing water quality and use on your land





# Management

## Step 1 - Water Saving

Fresh water supplies and demand are not evenly distributed at a country or local scale. Whilst agriculture accounts for only 2 - 3% of England's water usage, there are great regional differences, for example in Eastern England, it accounts for up to 16%. Water availability and demand are also different throughout the year. Understanding your water sources, potential water sources, availability and need are a key element in water management. Costed farm data (MDC 2006) shows mains water supply costs on the average dairy farm to be £31/cow/year, but this can be over £100/cow/year on some units, or in excess of 1 pence per litre of milk.

Since demand for water is likely to increase it is important to safeguard existing supplies and protect natural water sources. This is about reducing risk to your business and saving costs. Adopt a simple three point plan:

- Reducing water use where practical.
- Reusing water where possible, e.g. treating and reusing water for washing down yards and dirty areas.
- Recycling water such as collecting rainwater run-off from roofs and clean yard areas.

**In particular:**

1. Good housekeeping and attention to detail are needed. Assess the quantity of water needed, e.g. residential, livestock, pesticide and fertiliser applications and irrigation.
2. Assess the impact of specific practices and their use on others.
3. Be aware of any legal requirements for water use. The Environment Agency's website explains the need for a water abstraction licence in England and Wales.
4. Involve everyone on the farm to help identify use of water, reporting leaks etc., water saving ideas and ensure emergency procedures are in place.
5. Draw up a plan and timetable for water demand on farm, prioritising on the primary water uses.
6. Collect all clean roof water or direct into soak aways or drains. Do not allow this to mix with dirty water.
7. Determine the true cost of water use from each source and wastewater disposal on farm and, where possible, allocate consumption between enterprises.
8. Take steps to ensure accurate applications of all inputs to ensure that water pollution is avoided.
9. Assess farm practices that may lead to increased water evaporation or waste and amend where possible.
10. Identify areas prone to flooding and drought and aim to take remedial action to reduce the risk of adverse weather to your business.



**And where irrigation is used:**

Use water efficiently and monitor to optimise crop production and quality whilst giving due consideration to the environment and legal requirements (the need to hold an abstraction licence for irrigation is part of cross compliance - GAEC18). Base irrigation management decisions on crop needs, water availability, quality and appropriate application methods to optimise productivity and water use efficiency, including:

1. Schedule irrigation on the basis of accepted methods, such as evapotranspiration, forecasted rainfall or soil moisture deficits at different soil depths, etc.
2. Adopt practices that optimise water infiltration.
3. Provide operators with appropriate training to better understand irrigation scheduling and management.
4. Monitor and record water quality, methods and rates of application and timing in relation to scheduling and rainfall.
5. Where appropriate, apply nutrients, 'fertigation', through the irrigation system to enhance their availability to crop take up.
6. Consider appropriate water security measures, for example storage reservoirs, and manage them with due regard for water quality, safety and environmental benefit.
7. Select appropriate irrigation methods which provide good accuracy and placement.
8. Consider more efficient and accurate irrigation techniques, such as trickle irrigation and its cost to the business.

Simple checklist of practical steps you can take to save water

| Do you? | Please tick |
|---|---|
| Track your water use. | |
| Monitor your water meters and check readings so you can identify leaks in pipework running across your farm. | |
| Check around your farm routinely for signs of leaks or damage to water distribution and storage systems. | |
| Check insulation of pipework and tanks regularly, especially in the autumn, to prevent leaks. | |
| Know where stop cocks and shut off valves are located. | |
| Keep clean and dirty water separate. | |
| Look for equipment that is water efficient and flexible in use when purchasing new equipment. | |
| Identify the most appropriate methods of irrigation to prevent water loss. | |
| Use triggers on hoses to prevent water loss, don't leave hoses running. | |
| Identify water uses on the farm that can be met with collected rain water rather than mains water. | |
| Engage with staff and contractors so they understand why good practice with water is important and the ways in which they can support the business. | |
| Have an open mind to new ideas that can improve your business water footprint. | |
| **Total number of ticks** | |

Consider any actions you need to take after completing the checklist above then assess your water saving score from the table, right.



## Step 1 - Water Saving Score

| Indicator | Poor (0) | Medium (1) | Good (2) |
|---|---|---|---|
| **Management** | | | |
| Water saving ideas (a) | No long term plan in place to save water | Superficial plan in place but no real action taken | Measures in place and monitoring undertaken to ensure they are effective and reviewed annually |
| Regular water review (b) | No long term plan in place to regularly review water use and sources | Steps taken to review water use and some maintenance plans | Well planned procedure for reviewing water use and if you have to hold a water abstraction licence, you have checked it will meet your needs, especially in dry years |
| Clean and dirty water separation (c) | Not considered this | Considered how this can be done and the measures required to put in place, but not adopted | Measures in place and monitoring undertaken to ensure they are effective |

## Case Study - John Kirkbride, Billockby Farms, Norfolk

**Billockby Farms, just outside Great Yarmouth in Norfolk, is a mixed dairy, arable and potato farm that supplies milk into ASDA stores from its 420 cow herd.**

Working with ASDA John Kirkbride, the dairy manager, was keen to improve efficiency and marketability and in particular water use, both as drinking water for the cows and for washing down and cleaning out in the parlour. With each cow drinking between 90 and 190 litres of water per day, depending on their stage of lactation, water use is a key contributor to business costs.

The first steps he took were to identify water saving technology including rainwater harvesting facilities from the roof of the building as part of its overall investment and expansion plans. The new 24:48 swingover milking parlour has slashed milking times, and the business is well on track with plans to expand towards its 700 cow target. The investments have benefited from grant funding and the advice of their dairy consultant.

It is estimated that with a roof area of 1,800 $m^2$ and 660 mm of annual rainfall, 1,188 $m^3$ of rainwater will be collected annually. This is used for parlour and yard washing, saving on mains water usage and costs. The system required an above ground tank and suitable ancillary equipment in the form of pumps, piping and valves to appropriate points within the dairy unit.

The total investment in the rainwater harvesting elements was in the region of £19,580. This secured a 50% grant from the Norfolk Coast and Broads Local Action Group, so that the cost to the business was £9,790. Commenting on the development, John Kirkbride stated that he had not realised the full cost of water to the dairy side of the business. "With rising costs from mains water, trying to improve our own water quality and utilise our on farm resources has been critical. This was money well spent."



# Management

## Step 2 - Protecting Your Water Sources

Farmers can play a vital role in ensuring healthy watercourses, rivers, streams and oceans. Beneficial farming practices can protect water sources and improve water quality, helping reduce the risk of run off from inputs, restore wetland areas and peat bogs and tackle over-grazing, all helping improve water quality, efficiency and wildlife.

A fully integrated approach will help you develop a risk management plan for your farm. This needs to include contingency plans for any unplanned and/or natural events.

Management tools such as the LEAF Audit, Crop Protection Management Plans and Nutrient Management Plans will support you in improving water quality and protecting your water sources, helping your business become less vulnerable and more resilient and avoiding environmental damage and fines, as well as reducing rehabilitation and construction costs.

| Do you? | Please tick |
|---|---|
| 1. **Identify the main activities** on the farm that may create a risk to water quality. These may include pesticide use, manures and fertilisers, compaction and soil management, livestock, and waste. Also identify pollution risk areas (no spreading, very high risk, high risk and lower risk) where special care or avoidance of manure applications is needed, these should be highlighted on a Manure Management Plan. | |
| 2. **Identify the need for resource inputs** based on good livestock management, planned agronomy, previous cropping cycle, soil type and disease incidence, nutrient requirement to produce optimum crops in terms of yield and quality, whilst ensuring that nutrient use does not adversely impact on water quality, at a local or regional level. | |
| 3. Where inputs are used, **consider**: the accuracy of application, including well calibrated machinery, trained and competent staff, correct selection of nutrient and crop protection products, adoption of Integrated Pest Management (IPM) using a range of biological and alternative techniques for the economic control of pests, weather conditions at the time of application, the adoption of technologies which can help optimise resource use, i.e. nozzle type, precision farming, soil mapping, etc. | |
| 4. **Protect** boreholes, mains water supplies, and other water sources, such as rivers and streams, from potential contamination, including livestock access, run-off through inappropriate applications, soil erosion or diffuse pollution problems, not only on your own farm, but also those that could impact neighbouring businesses as well. | |
| 5. **Identify the river catchments** that your farm could affect, or be affected by. It can be easy to consider a business or farm in isolation, but water crosses farm boundaries and the solution to issues may be further upstream or need a number of stakeholders in a catchment to work together to understand issues and finds solutions. Catchment Sensitive Farming (CSF) delivers practical solutions and targeted support to enable farmers and land managers to take voluntary action to reduce diffuse water pollution from agriculture to protect water bodies and the environment. You may be able to access funding towards improved water management practices on your farm. | |
| 6. **Regularly check water courses** for signs of pollution and water troughs for leaks and damage, etc. | |
| 7. **Adopt mitigation measures** to protect water courses, including grass buffer strips located at the lower edges of fields, riparian buffer strips and constructed wetlands. These are seen as effective measures for mitigating pesticide contamination, via run-off/erosion and/or spray drift into surface waters, as well as where maize is grown, manure or slurry is applied or outdoor pigs are kept. | |
| 8. **Consider alternative approaches** where there are high risks of run-off for example tracks and wheelings as well as field drainage systems and areas prone to leaching. The only feasible mitigation measures are application rate reduction, product substitution and shift of application date, alternative cropping or developing biodiversity rich habitats. **Consider** the location and drainage of all tracks and wheelings to ensure run-off does not pollute water sources. | |
| 9. **Ensure you comply with the legislative requirements** relevant to your business and region, including disposal of dirty water, requirements of Nitrate Vulnerable Zones (NVZs) and Groundwater Source Protection Zones (GSPZs), handling, storage and application of artificial fertiliser (in solid and liquid form) and organic fertilisers, such as manure, compost, anaerobic digestate, and disposal of crop protection products, tank washings, wastes and fallen stock. | |
| 10. **Ensure stores are secure and sited with care**, regularly maintained and inspected with records being kept in accordance with legislative and farm assurance requirements. | |
| 11. **Clear up any spillage** of fertiliser, seeds, slug pellets, etc. to avoid water contamination. | |
| 12. **Ensure written emergency procedures are in place**, to include your OS location and relevant telephone numbers for the Environment Agency, neighbours, etc. Locate where they can be found by others who may be involved. | |
| **Total number of ticks** | |

Additional checklist of practical steps livestock farmers can take to protect water sources

| Checklist | Please tick |
|---|---|
| 1. **Consider the construction** of dedicated **cow tracks**. These can provide benefits to soil, water and animal welfare. Consider their siting carefully to ensure run-off and drainage does not pollute water sources and ensure these are well drained and comfortable for cattle to walk on. | |
| 2. **Increase access points** to fields to reduce poaching and ensure gateways are well managed and drained. Avoid allowing livestock direct access to rivers and streams. **Place uncultivated grass buffer strips in critical areas** where there is a high risk of erosion and run-off from grassland (see Step 4 - Drainage). Optimise your system for providing drinking water to livestock. Check routinely for evidence of leaks and consider positioning of watering points to prevent compaction, erosion and soil damage. | |
| 3. **Examine your daily routine** on the farm to ensure pollution risks are minimised, for example minimising dirty water production by separating clean and dirty water. Dirty water can be applied to grassland where a forage crop, such as a silage cut, is taken rather than on land that is being grazed. Timing of application is critical to prevent run off and contamination of drinking water sources and to minimise the risk of carryover of harmful bacteria into silage. With this in mind, consideration should be given to the presence of anaerobic bacterial spores in organic manures and waste water such as *Clostridium botulinum* as this can be a source of potential disease especially in cattle. Rates of application should match the capacity of the grass to utilise the nutrients and allowance made for its contribution, etc. | |
| 4. **Consider storing dirty water in the summer** so that it can be used beneficially, for example after cutting grassland. All dirty water storage tanks should be inspected on a routine basis for signs of leakage or deterioration. This includes underground tanks where specific camera systems may need to be used. | |
| 5. **Consider** fencing stock away from water courses. Remember it is possible to provide water for stock by using water rams or similar from the water courses. | |
| 6. **Consider** hard standing around water troughs, feeders and gateways. | |
| **Total number of ticks** | |



## Step 2 - Protecting Your Water Sources Score

| Indicator | Poor (0) | Medium (1) | Good (2) |
|---|---|---|---|
| **Management** | | | |
| Integrated Farm Management (IFM) including livestock, nutrient and crop protection management. (d) | Not considered this | Considered how this can be done and the measures required to put in place, but not adopted | Measures in place and IFM fully adopted, including undertaking monitoring to ensure they are effective |
| **Water protection total score from checklist (number of ticks from general checklist and livestock checklist, if applicable)** | | | |
| General (e) | 0 - 4 | 5-8 | 9-12 |
| Livestock (f) | 0 - 2 | 3-4 | 5-6 |
| Working with others (g) | Not considered this | Considered but do not know how to go about it | Sharing best practice through meetings, including Water Abstractor groups, contractors, the Environment Agency, social media and case studies |

# Physical Health

## Step 3 - Soil Management

Soil and water management are intrinsically linked and unique to each business, but you need to take into account:

- Slope, topography and soil type at field level
- Cropping plan, type of crops being grown and growth stage
- Livestock grazing patterns and conservation requirements i.e. silage, hay, maize, etc.
- Cultivation choice, level of organic matter and nutrient status

When thinking about water, the aim of soil management is to increase the soil holding capacity through improved organic matter status, cropping choice and cultivations (see Simply Sustainable Soils booklet) and crops 'Water Use Efficiency' (WUE). WUE is defined as crop yield per mm of water use. Broadly, practices that produce higher yields 'per drop' will improve WUE.

It is also important to remember that the objective of efficient crop and grassland production is to maximise business profitability in terms of £ per mm of rainfall (or water volume used). This will increase the Economic Water Use Efficiency (EWUE), which is an important factor when considering effective utilisation of the farm's resources and profitability. WUE is effected by soil type, evapotranspiration rate, cultivations, vapour pressure deficit and timing of rainfall events. To achieve high crop yields, we must aim to maximise the capture and storage of rainfall in the soil, the ability of the crop to utilise soil moisture and to minimise the severity of water deficits during key stages of crop development.

**You can influence crop and grassland WUE directly by:**

- Variety selection
- Timing of cultivations and drilling
- Drilling rate
- Avoiding compaction by livestock and machinery
- Soil structure and influence on root development
- Canopy management

**And indirectly by:**

- Minimising the effects of weeds and diseases that compete for soil moisture and limit the potential of the crop and grassland to access and efficiently use available soil moisture.
- Minimising wastage of the crop, avoiding field and storage losses, such as Dry Matter (DM) losses minimised, etc.

Points to consider in order to maximise nutrient use efficiency and WUE in both rain fed and irrigated conditions:

- **Identify areas at risk of soil erosion** that could cause widespread loss of soil or soil fertility, and affect water quality through transported sediments, nutrients and pesticides/pesticide residues, and ensure that appropriate cultivation and conservation measures are introduced.
- **Assess soil structure** using the Visual Soil Assessment (VSA) scoring tool (see Simply Sustainable Soils booklet).
- **Reduce soil structure degradation**. This can occur through over grazing *and* over cultivation, causing compaction and vital loss of the pore size distribution needed to maintain soil health. The potential for soil structural collapse and degradation varies regionally and from one soil type to another.
- **Adopt technologies that enhance soil structure and texture** through residue incorporation and mulching, soil conditioning, applying manure, or consider a change of cropping, for example, to grassland or agroforestry.

- **Implement cultivation choices and practices** to conserve soil such as cover cropping, minimum tillage, contour ploughing, developing buffer strips, field margins and riparian zones, optimising tillage techniques and implementing efficient and appropriate irrigation practices
- **Develop and adopt** a fully integrated approach to conserving the soil's water holding capacity, to ensure it is both free draining and has the ability to support root development and growth especially at times of water stress.

### Table 3: Step 3 - Soil Management Score

| Indicator | Poor (0) | Medium (1) | Good (2) |
|---|---|---|---|
| **Physical Health** | | | |
| Soil structure (VSA score) (h) | Hard, platy, aggregates difficult to break | Somewhat blocky | Crumbly, loose |
| Cultivation choice (i) | Continual ploughing | Minimum tillage adopted, but not in response to field conditions | Minimum tillage adopted and other measures such as cover crops and margins put in place as part of an integrated soil management approach |
| Monitoring (j) | No checking of field conditions or crop root structure through digging soil pits | Limited checking of field conditions or crop root structure through digging soil pits | Monitoring of soil conditions including soil sampling for nutrients routinely undertaken as part of the management approach |



# Physical Health

## Step 4 - Drainage

### Role of Drainage

Improved drainage holds enormous potential to increase agricultural productivity and also achieve sustainable natural resource protection. Yet field and soil drainage have received little attention to date in the global water policy debate. To exploit this potential, drainage must be viewed from an integrated perspective of land and water management, considering the interests of all water users and the multiple effects and impacts of agricultural drainage.

Awareness of the importance of drainage to sustainable farming is growing. The World Bank identified inadequate or inappropriate drainage as perhaps the most severe long term problem reducing the benefits of irrigation and leading to significant environmental effects.

Recent Environment Agency research showed that during the winter, 70% of maize stubble fields had poor soil conditions leading to run-off. One way to minimise this could be to undertake deeper cultivations post-harvest i.e. chisel plough, therefore loosening any compaction and increasing permeability.

Poor drainage, waterlogging and flooding hamper crop development and reduce output, yield and efficiency by:

- Reducing root respiration and total root volume
- Increasing resistance to transport of water and nutrients
- Allowing toxic compounds to accumulate
- Cooling the soil, thus delaying and slowing crop development
- Restricting access by field scale machinery, reducing the growing season
- Inability to access the land at the right time for specific tasks
- Reduced efficiency of fertiliser use
- Increased disease problems with livestock

## Key approaches on farm

When assessing soil drainage on your farm, the first step is to look for areas of surface water and wet patches in the fields. Then identify if you have a problem with a broken land drain perhaps due to deep cultivation, subsoiling or damage caused by growth of tree roots. It is important to ensure that cultivation is at a depth that will not cause damage and to manage land drains in line with good agricultural practice. Many field drains originate from Victorian times and are starting to deteriorate badly.

**Important steps to take include:**

- Maintain existing drains to ensure they are free flowing and outflows into ditches are not blocked.
- Manage drainage ditch clearance to ensure optimum water quality levels and to encourage wildlife, e.g. by adopting a planned strategy for ditch clearance in co-operation with neighbours and in line with stewardship agreements.
- Consider establishing field scrapes or reed beds.
- Monitoring water quality at field drain outlets.
- Develop field drainage maps and keep them up to date with any changes, such as new drains or outlets.
- Not draining environmentally valuable wetland areas and meadows. Wet woodland, wet grassland and wet meadows are very valuable habitats, rich in biodiversity.

## Sustainable Drainage Systems (SuDS)

Developing practical solutions for drainage is critical. In a joint project, carried out in 2010, LEAF and the Environment Agency explored the effectiveness of different farm level options designed to slow sediment flow and run-off from different farm and field locations.

The project demonstrated the effectiveness of a number of low cost options on farm, including:

1. Grassland scrapes
2. Grassland silt traps



Sustainable Drainage Systems provide a sustainable approach to managing the drainage of surface water and aim to better manage the future likelihood of flooding and water quality issues. SuDS achieve this through mimicking natural drainage and managing water above-ground with the characteristics of storage and slowing down flows of water into water courses as well as improving water quality and amenity.

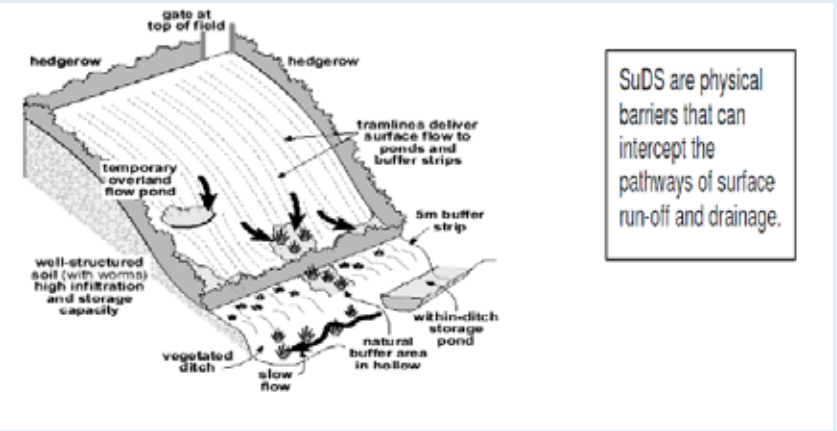



**Figure 2:** Sustainable drainage systems aim to alleviate these problems by storing or reusing surface water at source, by decreasing flow rates to water courses and by improving water quality (LEAF 2010).

**SuDS have multiple benefits in the agricultural landscape:**

**Improved water quality.** SuDS are very efficient soil and sediment traps. Through reducing the amount of sediment in run-off, there is good evidence to suggest that phosphorus, pesticides and faecal organisms are captured before they enter the main water courses.

**Reduced flood risk.** By capturing field run-off or intercepting the farm ditch network, the flow of water to a catchment can be adjusted to reduce peak flows at a local scale. There have been some interesting studies in the uplands through adjusting drainage systems (Moors for the Future 2012).

**Adaption to climate change.** Adapting our water availability and management are critical as we adapt to climate changes. If, as proposed, wetter winters and drier summers occur, they will be a challenge for farmers, who are at risk of reduced yields. SuDS encourage infiltration of water to recharge groundwater and with the creation of micro-wetlands can create a network of habitats for biodiversity to also allow for adaption. On-going diffuse pollution is often invisible to the naked eye, but in time of intense rainfall, the adverse effects of diffuse pollution can be seen with sediment in water run-off and ditches, gullies in fields and erosion of tracks. Adopting practical measures can reduce these risks.

3. Arable silt trap, sediment traps
4. Field buffers
5. Field/track buffers
6. Willow barriers and settlement pools
7. Reedbed and wetland areas

SuDS are designed to impact on a local and larger scale.

Where you have areas of high risk of run-off consider one of the 7 options above.

## Step 4 - Drainage Score

| Indicator | Poor (0) | Medium (1) | Good (2) |
|---|---|---|---|
| **Physical Health** | | | |
| Drainage management (k) | Standing water in field, no action taken. Risk of run-off into roads | Remedial steps taken to rectify drainage problems | Clear strategy in place to maintain drainage systems and take remedial action, if necessary, such as adopting SuDS |
| Pollution control (l) | No consideration for diffuse pollution | Steps in place to slow the run-off of water with SuDS systems | Routinely monitoring water quality, including turbidity/ sedimentation. Positively encouraging wildlife wetland areas |
| Contingency planning (m) | No long term plan in place to manage and avoid drainage issues | Some measures in place to ensure actions taken where problems occur | Well planned strategy in place to ensure regular drainage maintenance programme |



## Case Study - Jake Freestone, Overbury Farms, Gloucestershire

**Attention to detail has always been LEAF Demonstration Farmer Jake Freestone's philosophy, but when attending a LEAF water management training event he was challenged to look at ways of improving water quality.**

Added to this, as a Molson Coors Brewing Company malting barley supplier, Jake was only too aware of his role in reducing the water footprint of the beer as part of his commitment to an integrated supply chain. Focusing on addressing these corporate and social responsibilities, Jake set about looking at what additional measures he could take on this mixed arable and sheep farm in Gloucestershire.

One step he took was the creation of a silt trap and reed bed in a ditch line to try and reduce the farm's impact on water quality. Following two dry winters in 2010 and 2011, he took the opportunity to dig out a portion of one of his ditches to create a wider and deeper area. Together with stones laid at the bottom, the idea was to slow down the water flow so that any particles would drop out and lie as silt which later could be dug out and returned to the fields. As the soil particles have the potential to carry pesticides and fertilisers, this feature will improve localised water quality.

Once the water has passed through the silt trap area, the ditch is returned to its normal flow for around 7 to 8 metres and then a second area where a reed bed has been located. Over time, as this reed bed becomes more established, it will act as a natural water filter and remove nitrates, phosphates, etc. that might be in a soluble form within the water, thus improving water quality before the water continues back on the ditch line and into the stream.

After two years, the ditch is running freely and the impact on nutrient levels is being investigated.

Other options such as developing buffer strips close to water courses and ditches can supplement this low cost approach. As Jake uses the principles of Integrated Farm Management (IFM) to manage his business, these measures sit alongside other developments such as improving control of diffuse water pollution. In particular, precision farming techniques have been adopted across the farm, recognising the importance of accurate applications, crop demands and yield.

# Monitoring

## Step 5 - Tracking Your Water Use

The most practical approach to assess water management on your farm is to consider your current levels of control.

The LEAF Water Management Tool has been designed to help you with managing your water use and also the impact of various farm enterprises on water sources around the farm; it will also help you in tracking your water use.

Map the location of water meters on the farm and install additional meters in strategic places. Record usage, the frequency of recording depends on the amount of water you use and how important it is for your business to know the cost of water or legal requirements, e.g. for an abstraction licence. Many farm assurance standards require daily recording of water meter readings as an aid to managing animal welfare. This is particularly associated with intensive livestock production where a sudden change in water consumption can be an early indicator of a disease challenge or stress in the animals. Intensive horticulture will also monitor moisture levels on a daily basis to manage crop health and nutrition especially where crops are being grown on inert matter such as Rockwool or coir.



The Tracking Water Checklist below will help you to track your water use:

| Do you? | Please tick |
|---|---|
| 1. **Map the location of water meters** and take and record readings on a regular basis. Undertake a frequency of water meter checks that fits with your business (and legal needs if appropriate) and keep either manual records or record electronically in a simple spreadsheet. Ensure meters are calibrated and accurate. | |
| 2. **Ensure that sufficient meters are available** or additional water meters installed, where water is extracted, such as from mains, spring and surface water, boreholes, etc. and wherever there are branches in all delivery pipes and strategic places. Sub-meters can help you identify water use by enterprise. | |
| 3. **Identify trends in the data observed**. Review your records on a regular basis to assess that they are what you would expect, i.e. has water use suddenly gone up or down? If so investigate. Benchmark your expected water use either using your own data or industry guidelines. | |
| 4. **Pinpoint areas for improvement** that will improve efficiency and reduce water costs. Once you start tracking your water use identify areas for improvement (see Step 1 - Water Saving). Can you change the ratio of the sources of water to reduce costs or the environmental impact of water use i.e. mains water, harvested rainwater, surface water, ground water or recycled water? | |
| 5. **Use the LEAF Water Management Tool** as a business health check for water use on your farm. | |
| **Total number of ticks** | |

## Step 5 - Tracking Your Water Use Score

| Indicator | Poor (0) | Medium (1) | Good (2) |
|---|---|---|---|
| **Monitoring** | | | |
| Water usage monitoring (n) | Mains water use recorded on water bills, or for legal requirements, but no further action taken | Interim water readings taken by staff to monitor water use for all sources of water on the farm | Water readings analysed by management to look for trends and identify opportunities for improvement |
| Water audit (o) | No long term plan to identify opportunities for improvement in how water is used on the farm | Routine walk-about on the farm to identify areas where water could be managed more effectively | Completing the LEAF Water Management Tool with action plan together with responsibilities and timescales for actions |
| Tracking Water Use Checklist score (p) | 0 - 1 | 2 - 3 | 4 - 5 |



# Monitoring

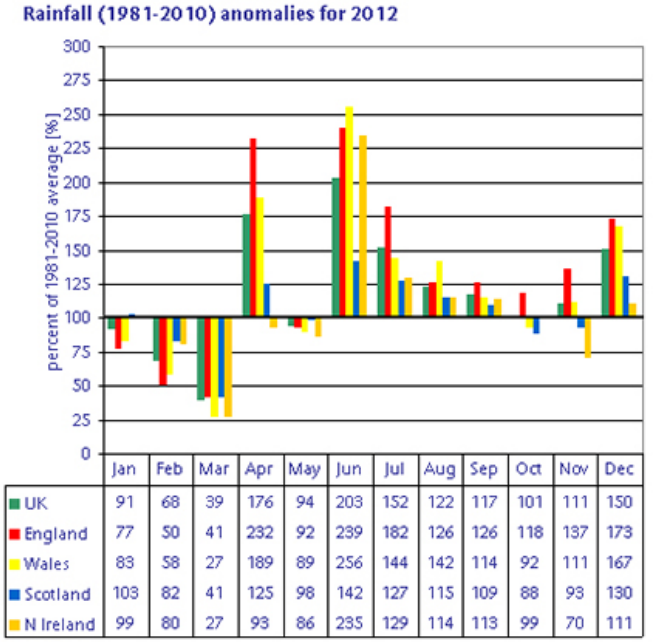
## Step 6 - Water Availability and Sunshine Hours

### Water Availability

At its most basic level, farming and food production is about making calories for humans to consume from complex processes, such as photosynthesis or animal metabolism. Farmers need to be aware of the opportunity to enhance these processes by making the best use of sunshine and rainfall to produce food at the required yield and quality.

However, hugely variable and unpredictable patterns of rainfall and sunshine hours increasingly create challenges for farming businesses (Figure 3).

Figure 3 shows the huge anomaly for weather in 2012 across the UK, with a very dry spring and a wet summer.

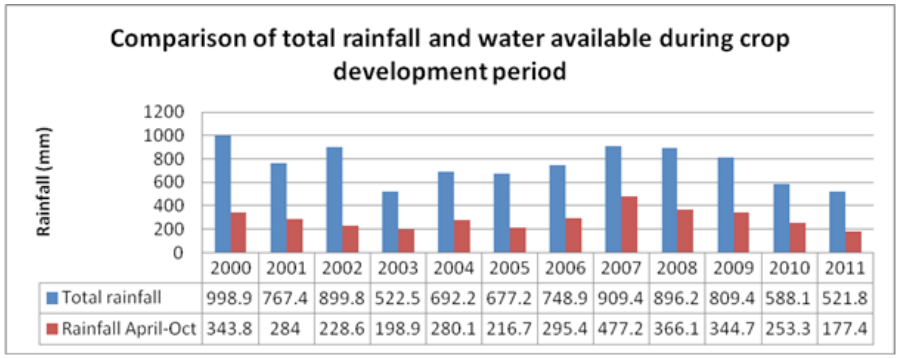



| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UK | 91 | 68 | 39 | 176 | 94 | 203 | 152 | 122 | 117 | 101 | 111 | 150 |
| England | 77 | 50 | 41 | 232 | 92 | 239 | 182 | 126 | 126 | 118 | 137 | 173 |
| Wales | 83 | 58 | 27 | 189 | 89 | 256 | 144 | 142 | 114 | 92 | 111 | 167 |
| Scotland | 103 | 82 | 41 | 125 | 98 | 142 | 127 | 115 | 109 | 88 | 93 | 130 |
| N Ireland | 99 | 80 | 27 | 93 | 86 | 235 | 129 | 114 | 113 | 99 | 70 | 111 |

**Figure 3:** Rainfall (1981 – 2010) anomalies for 2012 (Met Office 2012)

With such rainfall variability from year to year, the need to effectively manage this variance is increasingly creating challenges for each farming business, whether the enterprises are rain fed or irrigated. However, whilst the overall annual rainfall data is of interest, especially if the farm has capacity to store water over winter for use in the summer, it is not as important as the rainfall available to the crop during the crop growing cycle (Figure 4).

Figure 4 illustrates that less than a third of annual rainfall can take place at a time when the crop can readily take up the water in the growing period. It can be argued that winter rainfall, if it is not retained on farm, should not form part of the water footprint of agriculture.




| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total rainfall | 998.9 | 767.4 | 899.8 | 522.5 | 692.2 | 677.2 | 748.9 | 909.4 | 896.2 | 809.4 | 588.1 | 521.8 |
| Rainfall April-Oct | 343.8 | 284 | 228.6 | 198.9 | 280.1 | 216.7 | 295.4 | 477.2 | 366.1 | 344.7 | 253.3 | 177.4 |

**Figure 4:** Variance between total rainfall and rainfall available during the growing period in Ross-on-Wye, Herefordshire (Met Office, 2012)

For farming enterprises that rely on the availability of significant quantities of water, such as horticulture or indoor livestock production, water management involves assessing water use. The volume of water required can be predicted and that amount split between rainfall, surface water and groundwater, as well as mains water, depending on individual business resources. Monitoring during the growing period can then allow farmers to change their water mix in order to meet crop requirements as well as effectively managing costs.

The opportunity for recycling and reusing water should also be considered, but it is essential that the chemical and microbiological standard of the water is high. If potable standard water is required, this will add to the cost of production, since mains water must be used.



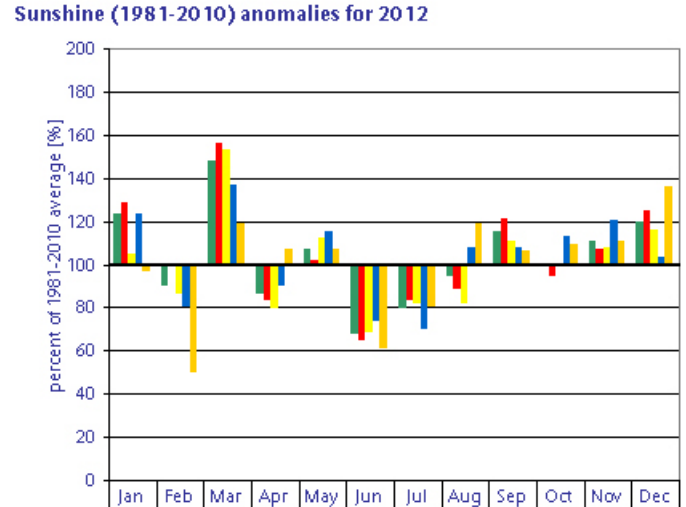
Water quality will also impact on food safety e.g. potential *E. coli* 0157 contamination of irrigation water or *Campylobacter* contamination of water used for livestock.

The LEAF Water Management Tool can help you identify the relevant questions about water management for your business and identify weak areas where action needs to be taken.

## Sunshine hours

Another factor which impacts greatly on agricultural productivity is sunshine hours. Rainfall patterns and sunshine hours go hand in hand. The pattern of annual sunshine hours (Figure 5) shows the significant anomalies for 2012 for the UK (Met, 2012).

It is the sunshine hours available at the specific crop development stage that is of most importance. At a more specific level, Figure 6 illustrates




| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UK | 124 | 90 | 148 | 86 | 107 | 67 | 80 | 95 | 116 | 100 | 111 | 120 |
| England | 129 | 99 | 156 | 83 | 102 | 65 | 83 | 89 | 121 | 94 | 107 | 125 |
| Wales | 105 | 86 | 153 | 80 | 112 | 68 | 82 | 82 | 111 | 99 | 108 | 116 |
| Scotland | 123 | 80 | 137 | 90 | 115 | 74 | 70 | 108 | 108 | 113 | 120 | 103 |
| N Ireland | 96 | 50 | 119 | 107 | 107 | 61 | 80 | 119 | 106 | 110 | 111 | 136 |

**Figure 5:** Sunshine (1981 – 2010) anomalies for 2012 (Met Office 2012)

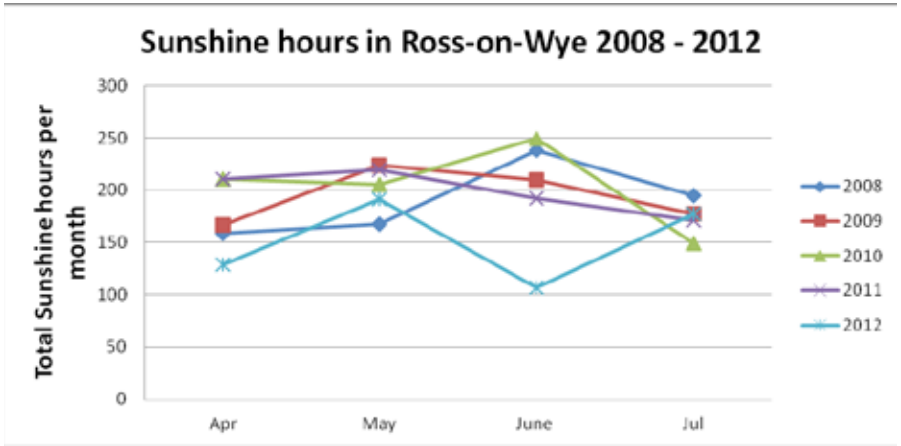



**Figure 6**: Sunshine hours recorded at Ross-on-Wye, Herefordshire between April and July 2008-2012 (Source of data: Met Office, 2012)

the challenges of this variability at Ross-on-Wye over a five year period. Comparing the sunshine hours by month for 2012 to an average of the previous twelve years, whilst in May and July the sunshine hours were over 90% of the average, in April they were 73% of average; but in June down to 49% of the average. This had an impact on grass, cereal and fruit development. For horticultural crops such as soft and stone fruit, loss of sunshine hours at a critical time will cause a resultant reduction in the brix level (sugar level) and thus create challenges in meeting customer specifications.

This huge variability is virtually impossible to predict until we have more effective long term weather forecasting, but you can ensure that you are familiar with your rainfall, water availability during the growing season and likely sunshine hours and patterns.



**What can you do as a farmer?**

1. Be aware of your water requirements not only in terms of water quantity, but also quality.
2. Understand the importance of air and soil temperature and sunshine hours and monitor them as a way of predicting crop quality.

The table below will help you identify a score for sunshine hours and water quantity monitoring.

## Step 6 - Water Availability and Sunshine Hours Score

| Indicator | Poor (0) | Medium (1) | Good (2) |
|---|---|---|---|
| **Monitoring** | | | |
| Water quality and quantity (q) | Not really considered | Water needs have been considered and steps have been introduced to manage water use and the potential for diffuse pollution | Clear strategy in place with a water management plan having been adopted |
| Sunshine hours (r) | Sunshine hours are something that is not paid much attention | Sunshine hours have been considered but routine monitoring is not in place | Clear strategy in place to monitor sunshine hours and the impact on crop production |
| Soil and air temperature (s) | Soil and air temperature are not something that is paid much attention | Soil and air temperature have been considered but routine monitoring is not in place | Clear strategy in place to monitor soil and air temperature and the impact on crop production |

## Case Study - Simon Wells, Lower Hope Fruit Ltd, Herefordshire

**Producing fruit of the highest quality is the overarching aim of Lower Hope Fruit Ltd in Herefordshire. As an award winning British cherry grower they pay attention to the 'terroir' of the land they farm, in terms of soil type, aspect and slope, access to good quality water for irrigation and the microclimates in terms of daily air temperature, humidity and sunshine hours. Having recently installed an array of photovoltaic cells on their pack-house roof they are harnessing the energy from sunshine in more ways than one.**

As a business the growing season of 2012 really showed the impact of low air temperatures and low sunshine hours and intensity in terms of fruit yield and quality. These requirements are especially important in that retail partners are balancing their promotional activity of British fruit especially cherries within a season that has such natural fluctuations from year to year.

Simon Wells, Managing Director, said that "It was of great concern to us that the level of sunshine hours was 50% below average in June 2012. It did have an impact on our season and is a factor totally outside our control. Although we grow a range of varieties of cherries that are early, middle and late season to try and make the most of what nature offers, we have in the past and will continue in the future to focus on air temperature, sunlight intensity and sunshine hours as important factors to measure."



# How are you doing?

Now you have carried out the **Simply Sustainable Water - Six Simple Steps for managing water quality and use on your land**, how did you do?

Complete the table overleaf to get an idea of how well you are managing water. Develop an action plan for the areas where you think you can improve. Revisit your score on an annual basis. These are the first steps to developing a more sustainable water strategy for your business.

### Overall score for your business:

Poor: 0 - 4

Medium: 5 - 8

Good: 9 - 12

Photocopy the sheet overleaf for each farming year and make a clear plan for your farm.

### Next Steps

- Identify your score and areas for improvement and put an action plan into place.
- Revisit your water management plan on a regular basis and update as you implement improvements.
- Share your results with staff, contractors and family. Can they highlight additional measures you can take to improve water quality?
- Use the LEAF Water Management Tool.
- Arrange meetings with customers and neighbours to understand risks and opportunities within your catchment area.

**Your score:**
**Year:**

| Indicator | Score (0,1,2) |
|---|---|
| **Step 1 - Water Saving** | |
| Water saving ideas | (a) |
| Regular water review | (b) |
| Clean and dirty water separation | (c) |
| **Step 1 Total** | (a+b+c)/3 |
| **Step 2 - Protecting Your Water Sources** | |
| Integrated Farm Management (IFM) including livestock, nutrient and crop protection management. | (d) |
| Water protection score from checklist | |
| General checklist | (e) |
| Livestock checklist | (f) |
| Working with others | (g) |
| **Step 2 Total** | (d+e+g)/3 or (d+e+f+g)/4 |
| **Step 3 - Soil Management** | |
| Soil structure (VSA score) | (h) |
| Cultivation choice | (i) |
| Monitoring | (j) |
| **Step 3 Total** | (h+i+j)/3 |
| **Step 4 - Drainage** | |
| Drainage management | (k) |
| Pollution control | (l) |
| Contingency planning | (m) |
| **Step 4 Total** | (k+l+m)/3 |
| **Step 5 - Tracking Water Use** | |
| Water usage monitoring | (n) |
| Water audit | (o) |
| Tracking water use checklist score | (p) |
| **Step 5 Total** | (n+o+p)/3 |
| **Step 6 - Water Availability and Sunlight Hours** | |
| Water quality and quantity | (q) |
| Sunshine hours | (r) |
| Soil and air temperature | (s) |
| **Step 6 Total** | (q+r+s)/3 |
| **Overall** | |



# Further information

There is a wide range of information on how to improve water use and minimise the impact of farming practices on water resources. These are readily available for farmers, including:

- LEAF Water Management Tool, LEAF Audit and the LEAF Green Box
- Effective use of water on dairy farms (DairyCo)
- The Environment Agency website (www.environment-agency.gov.uk)
- Waterwise on the Farm – Version 2 (Environment Agency, NFU and LEAF)
- Further links are available on www.leafuk.org/leaf/farmers/sswfurtherlinks

# References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LINKING ENVIRONMENT AND FARMING
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