Water Management

Irrigation management
FSA54, 55, 56, 58, 62

Irrigation water quality
FSA53

Water pollution management
FSA56, 58, 59, 60, 61

Optimised irrigation method
FSA57

FSA FARM SUSTAINABILITY ASSESSMENT BY SAI PLATFORM

Compiled by : NIAB

Irrigation Management

Best practice :

Have an irrigation plan that :

- Optimises water use according to plant needs
- Prevents pollution
- Includes a record of water usage.

Be fully aware of regulations referring to water extraction, use and treatment.

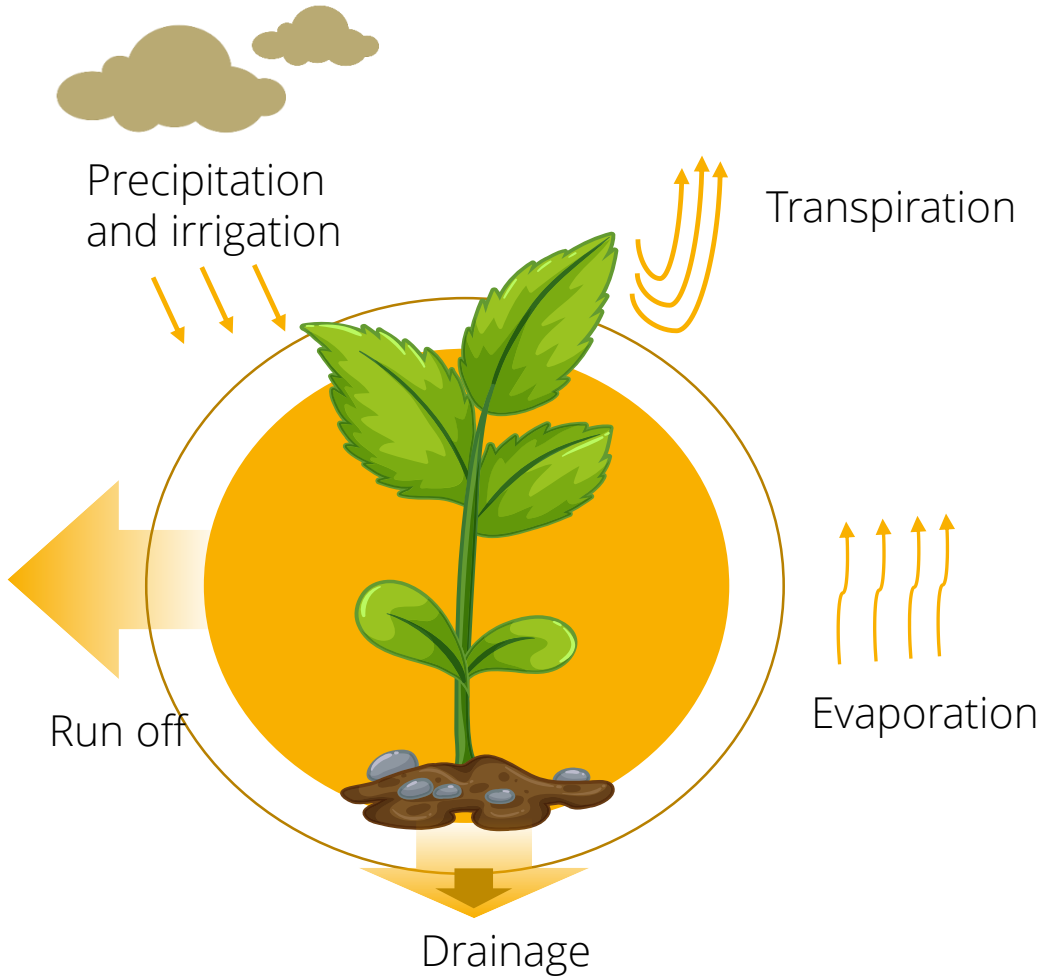
FSA56	If you irrigate do you ensure that any water use, other than rain, is approved by the relevant authorities to ensure that water extraction levels are sustainable?
FSA58	If you irrigate and / or treat water on farm, do you ensure that the water use is in compliance with applicable regulations, including food safety, water supply and national legislation?
FSA54	If you irrigate, do you have a water use plan to optimise water usage and to reduce water loss?
FSA55	If you irrigate, do you have a management plan to optimise water usage, quality, and availability and to reduce waste water?
FSA62	If you irrigate, do you maintain irrigation records?

Irrigation Management

It is important to increase water use efficiency to avoid waste and, in turn, help to control costs. In planning your irrigation define your water requirements based on availability, local climate, soil type, crop and intended market. You may already have irrigation installed so the challenge is to manage that system as efficiently and sustainably as possible.

There is no one irrigation system that is best for all situations. For example, drip irrigation provides an opportunity for significant water savings and yield increases for certain crops in areas where irrigation is used throughout the season. However it may not be suitable for crops that only need supplemental irrigation or in certain crop rotations. Compared to other well-managed systems, the water savings in converting to drip irrigation may be marginal.

Be aware of the requirements for permits and licenses for water abstraction and discharges to groundwater and watercourses. It may be possible that water abstraction and harvesting is legal but it can still be unsustainable. It is important to manage irrigation to ensure efficient use, to protect supplies and to minimise water contamination by runoff from the land, which can have an effect on biodiversity and local communities.



Irrigation Management

- Monitor current water use, and where necessary estimate water consumption by using a suitable container (of known volume) and stopwatch to check flow rates. Once a baseline of water use is established take proactive steps to increase efficiency and optimise water use.
- Do not rely on memory. Carry day sheets or a field book and keep records of water usage.
- Regularly checks for leaks. This includes visual checks for dripping taps, leaky pipes, hoses and nozzles, and for unusually wet areas around the pipe network.
- Keep up-to-date with developments for water use within your area.
- Consider using boom irrigation to apply water more accurately than a gun. For some crops, drip irrigation can be used to reduce water consumption.
- Check weather conditions before irrigating, e.g. windy conditions can cause uneven application.
- Irrigating at night, in the early morning or late evening will reduce loss (evaporation) of water, but be aware of potential noise nuisance when siting your pump.
- To prevent sealing or capping of the soil surface and to reduce run-off, ensure irrigation is applied evenly and that droplet size is not too big.
- Where necessary, isolate from the water source and drain the pipes that are not in use over winter to prevent freezing.

How to answer YES

Ensure you hold any relevant licenses and permits for water abstraction and for discharges to groundwater and water courses (FSA56).

Be aware of regulations referring to water use and treatment. Avoid the use of contaminated water to irrigate food crops (FSA56, 58).

Have a water use plan that includes pollution prevention, minimising water use and minimising competition for water resources (FSA54, 58).

Show how your irrigation management plan can help you identify areas for improvement (FSA55, 62).

Be able to demonstrate how you ensure water access throughout the growing season (FSA55).

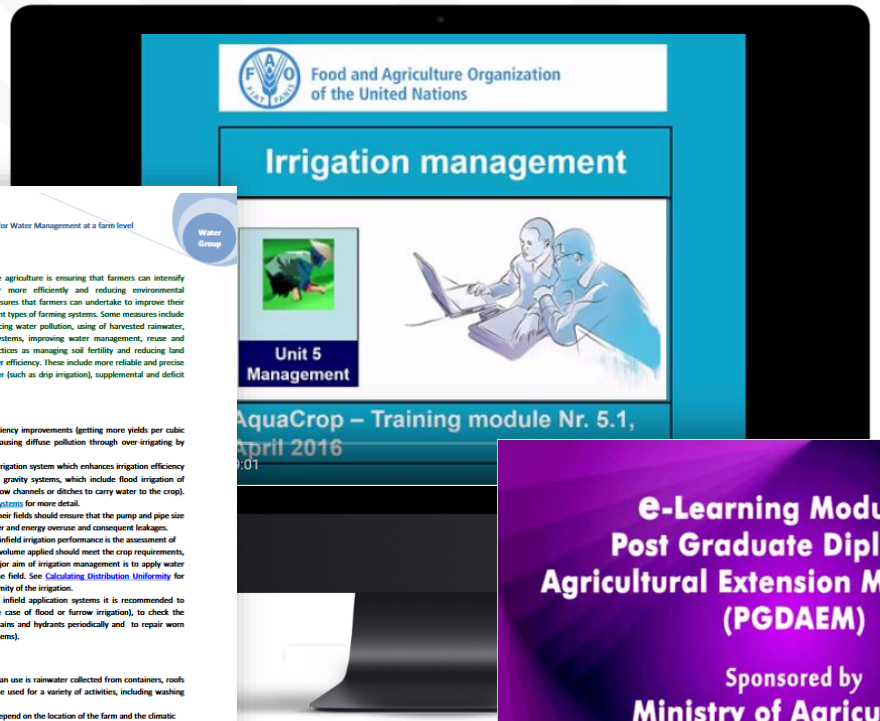
Check your irrigation system to ensure pipework and water infrastructure is in good condition without leaks. Show how you make regular checks of pumps, mains pipe, hydrants, supply hoses and irrigators, carrying out necessary repairs (FSA54, 55).

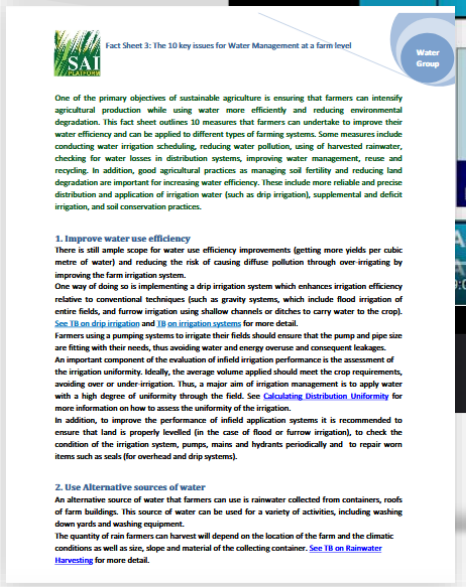
Ensure the abstraction/withdrawal quantities and aquifer levels are maintainable in the long term and other water users are not compromised (FSA55).

Keep clear records of rainfall (and evapotranspiration if possible), water testing, water usage, scheduling, operator training and equipment maintenance across all cropping areas (FSA55, 62).

Irrigation Management

FAO: Irrigation management AquaCrop




Fact Sheet 3: The 10 key issues for Water Management at a farm level

One of the primary objectives of sustainable agriculture is ensuring that farmers can intensify agricultural production while using water more efficiently and reducing environmental degradation. This fact sheet outlines 10 measures that farmers can undertake to improve their water efficiency and can be applied to different types of farming systems. Some measures include conducting water irrigation scheduling, reducing water pollution, using of harvested rainwater, checking for water losses in distribution systems, improving water management, reuse and recycling. In addition, good agricultural practices as managing soil fertility and reducing land degradation are important for increasing water efficiency. These include more reliable and precise distribution and application of irrigation water (such as drip irrigation), supplemental and deficit irrigation, and soil conservation practices.

1. Improve water use efficiency

There is still ample scope for water use efficiency improvements (getting more yields per cubic metre of water) and reducing the risk of causing diffuse pollution through over-irrigating by improving the farm irrigation system.

One way of doing so is implementing a drip irrigation system which enhances irrigation efficiency relative to conventional techniques (such as gravity systems, which include flood irrigation of entire fields, and furrow irrigation using shallow channels or ditches to carry water to the crop). See TB on drip irrigation and TB on irrigation systems for more detail.

Farmers using a pumping systems to irrigate their fields should ensure that the pump and pipe size are fitting with their needs, thus avoiding water and energy overuse and consequent leakages.

An important component of the evaluation of infield irrigation performance is the assessment of the irrigation uniformity. Ideally, the average volume applied should meet the crop requirements, avoiding over or under-irrigation. Thus, a major aim of irrigation management is to apply water with a high degree of uniformity through the field. See Calculating Distribution Uniformity for more information on how to assess the uniformity of the irrigation.

In addition, to improve the performance of infield application systems it is recommended to ensure that land is properly levelled (in the case of flood or furrow irrigation), to check the condition of the irrigation system, pumps, mains and hydrants periodically and to repair worn items such as seals (for overhead and drip systems).

2. Use Alternative sources of water

An alternative source of water that farmers can use is rainwater collected from containers, roofs of farm buildings. This source of water can be used for a variety of activities, including washing down yards and washing equipment.

The quantity of rain farmers can harvest will depend on the location of the farm and the climatic conditions as well as size, slope and material of the collecting container. See TB on Rainwater Harvesting for more detail.

SAI: Fact Sheet 3: The 10 key issues for Water Management at a farm level

Tamil Nadu Agricultural University: Irrigation and Rain Water Management

Further reading and examples:

- FAO: Aquacrop webpage
- FAO: Land and water
- FAO: Guidelines for Planning Irrigation and Drainage Investment Projects
- DEFRA, UK: Irrigation Best Practice A Water Management Toolkit for Field Crop Growers
- FAO: Irrigation Techniques for Small-scale Farmers: Key Practices for DRR Implementers

FSA FARM SUSTAINABILITY ASSESSMENT BY SAI PLATFORM

Irrigation Water Quality

Best practice :

Have a risk assessment for the frequency and timing of water analysis and the tolerance limits for potential contaminants.

Use a written water management plan to record analysis results, availability of water resources and irrigation scheduling.

Monitor and manage water quality.

FSA53 If you irrigate, do you periodically assess irrigation water quality and properly manage it, based on the analysis results?

FSA55 If you irrigate, do you have a management plan to optimise water usage, quality, and availability and to reduce waste water?

Irrigation Water Quality

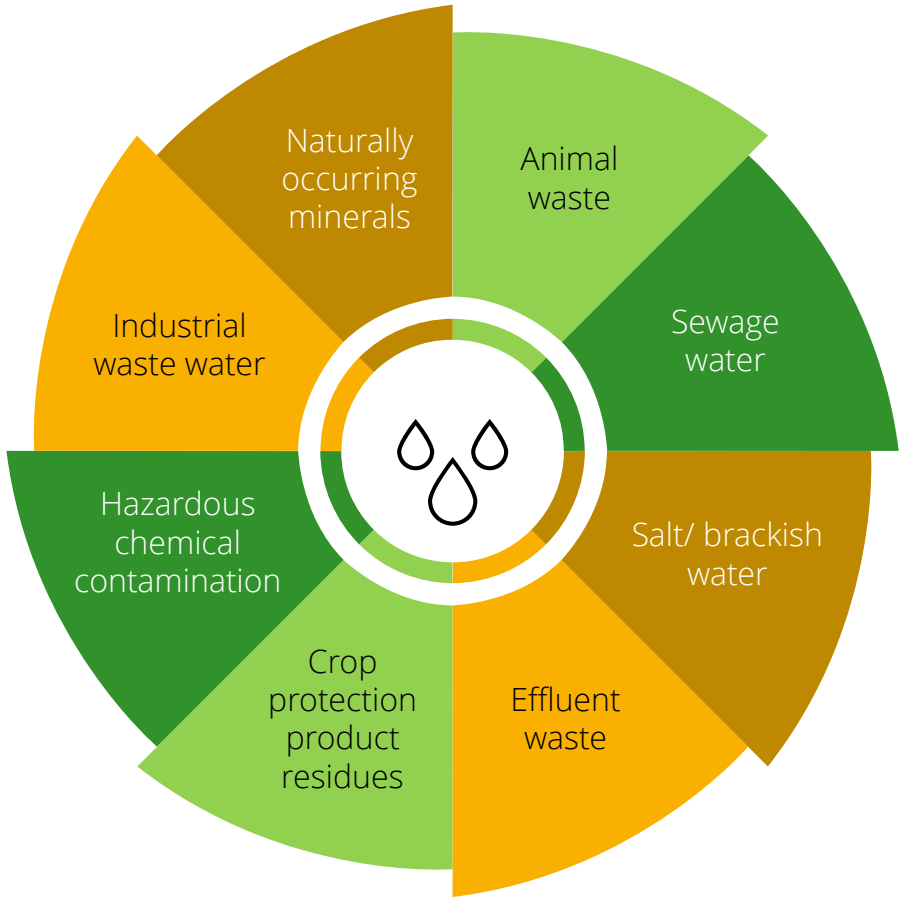
The quality of water can vary greatly depending upon the type and quantity of chemicals, dissolved salts and micro-organisms it contains. For example it is particularly important to be sure of high-quality irrigation water where:

1. there is a risk that irrigation will contaminate a crop and make the product unsaleable (e.g. with heavy metals, pathogenic bacteria (such as *Salmonella* spp., *Listeria monocytogenes* and *Escherichia coli* O157:H7) or crop protection product residues);
2. salts in the water will impact on:

- water infiltration rates. High sodium or low calcium content of soil or water reduces the rate at which irrigation water enters the soil to such an extent that sufficient water cannot be infiltrated to supply the crop adequately from one irrigation to the next with an increase in run-off rates;
- specific ion toxicity. Certain ions (e.g. sodium, chloride, or boron) from soil or water accumulate in a sensitive crop to concentrations high enough to cause crop damage and reduce yields to the point where the soil becomes unsuitable for crop production;
- product quality. Excessive nutrients cause unsightly deposits on fruit or foliage reducing marketability.

To avoid crop contamination and damage, as well as soil contamination and damage, it is essential to monitor water quality and manage it when necessary.

Sources of poor quality water



Irrigation Water Quality

The following steps will help in putting together a monitoring plan:

- Identify the likely problems in the local area or irrigation water source;
- Identify the tolerance limits for the potential contaminant(s) using FAO Irrigation Water Quality Guidelines, but also consider local regulations;
- Identify a suitable test methodology or local provider of water testing services (any provider should have some sort of quality accreditation);
- Identify the necessary monitoring frequency and relevant timing (seasonality) for sampling. This will vary between contaminants and will be determined by risk assessment;
- Identify management actions required for results outside tolerable limits;
- Ensure that the necessary monitoring takes place and those records are kept. At a minimum, this would be a basic quality assessment (water analysis).

National water quality standards should be adhered to or, if none, FAO or USDA standards should apply. Particular attention needs to be paid to prevention of salinisation and sodicity through use of poor quality water.

How to answer YES

Show that you have carried out a risk assessment to determine the frequency of analysis of irrigation water quality (FSA53).

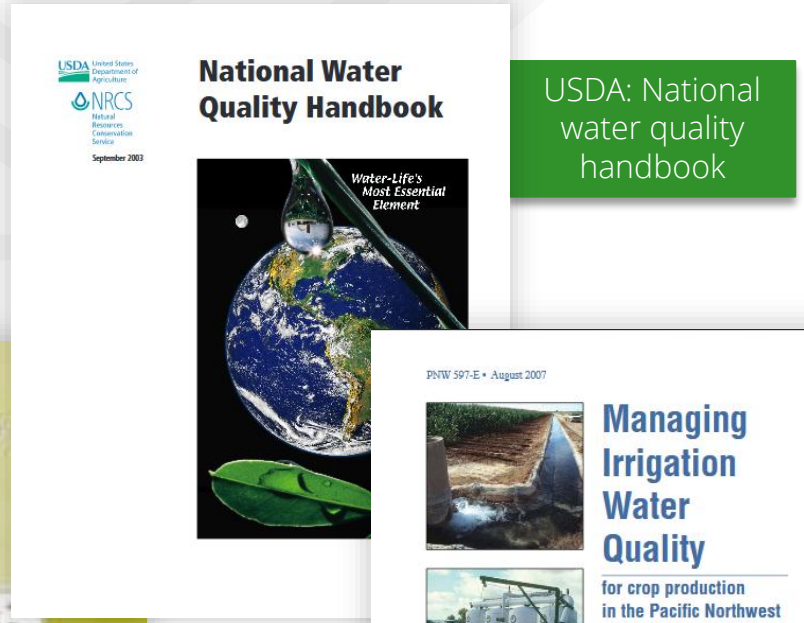
Have a written water management plan (FSA55).

Monitor irrigation water quality, recording the results of any analysis (FSA53, 55).

Be able to show evidence of any treatment to manage water quality (FSA53, 55).

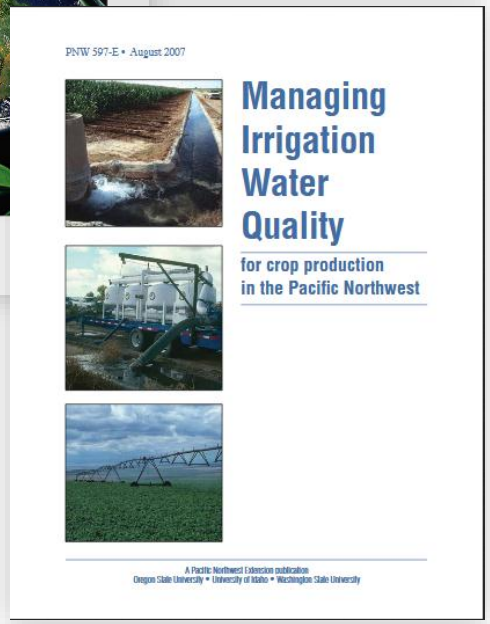
Show records are maintained of testing, remedial actions and fields where the water has been used (FSA53).

Irrigation Water Quality



USDA: National water quality handbook

FAO: Water quality for agriculture



Oregon State University: Managing irrigation water quality

Further reading and examples:

- FAO: Water harvesting techniques
- FAO: Irrigation with wastewater
- South African water quality guidelines, Volume 4 Agricultural Water Use: Irrigation
- Texas A&M: Irrigation water quality standards and salinity management
- Cropnuts AG: Why Do an Irrigation Water Analysis? (Video)

FSA FARM SUSTAINABILITY ASSESSMENT BY SAI PLATFORM

Water Pollution Management

Best practice :

- Comply with all guidelines and regulations with respect to water extraction, use and treatment.
- Manage waste water to prevent pollution.
- Establish buffer zones and adopt working practices to prevent run-off of any inputs.
- Take measures to control erosion.

FSA56	If you irrigate, do you ensure that any water use, other than rain, is approved by the relevant authorities to ensure that water extraction levels are sustainable?
FSA58	If you irrigate and / or treat water on farm, do you ensure that the water use is in compliance with applicable regulations including food safety, water supply and national legislation?
FSA59	Do you take measures to avoid water and soil pollution from waste water?
FSA60	Do you employ practices to prevent the run-off of any chemical, mineral and organic substances (including crop protection products, fertilisers and manure) that may pollute the environment?
FSA61	Do you establish buffer zones adjacent to water to control erosion, prevent pollution, and create and protect a wildlife habitat?

Water Pollution Management

Water pollution is an issue of global concern, as many countries are experiencing deteriorating water quality combined with growing demand. It is driven by population growth, deforestation, industrial development and agricultural development. It is also exacerbated by factors such as changes in ecosystem composition and climate change. As such, nothing which poses a pollution risk should be discharged either directly or indirectly in to streams or rivers.

On farm land, irrigation and drainage are associated with a deterioration of water quality caused by run-off and leaching of salts, hazardous chemicals (such as oil, crop protection product residues and fertiliser) leading to water pollution, eutrophication and the contamination of drinking water sources.

Diagnosis, prediction and monitoring are key requirements of a pollution management systems and must be integrated into your farm water management plan.

The transfer continuum for nutrients

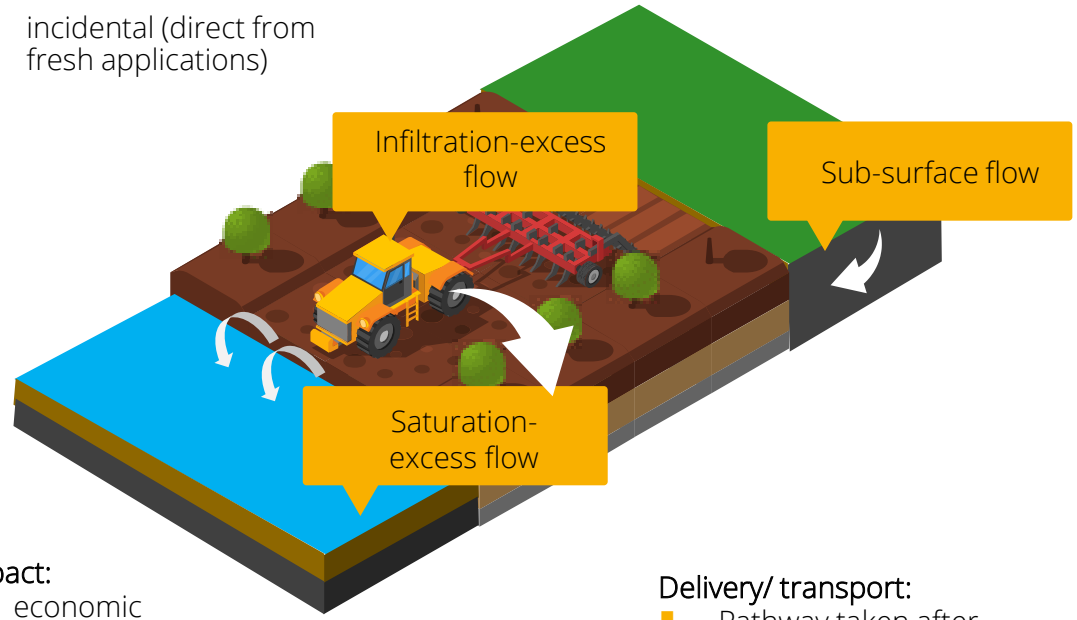
Mobilisation:

Start of journey from soil or source, either:

- solubilised (as a solute)
- detached (attached to colloids)
- incidental (direct from fresh applications)

Sources:

- fertiliser application
- feed input to animals



Impact:

- economic
- sociological
- biological
- ecological

Delivery/ transport:

- Pathway taken after mobilisation to the watercourse

Water Pollution Management

- Protect habitats of adjacent environments by:
  - not lowering the water-table;
  - preventing spray drift;
  - preventing nutrient and sediment rich run-off.

If these are an issue then carry out activities to address the issue.

- Avoid applying water where there is no yield or quality benefit (including taking account of weather forecasts), and prevent contamination of water bodies with soil nutrients, fertilisers and pesticides or soil.
- Check ditches, surface waters and clean water drains for signs of pollution.
- Use buffer strips and other measures to reduce surface run-off from fields.
- Do not apply crop protection products, fertilisers, manures, treated sludge or dirty water:
  - within 10 metres of any ditch, pond or surface water;
  - within 50 metres of any spring, well, borehole or reservoir that supplies water for human consumption or for farm dairies;
  - on very steep slopes where run-off is a high risk throughout the year;
  - on any areas where you are not allowed to because of specific management agreements.
- Livestock manures and dirty water can cause serious water pollution. Storage systems that are properly designed, built and maintained will reduce these risks.

How to answer YES

Be aware of regional and national regulations referring to water extraction, use and or treatment (FSA56, 58).

Have all required licences and permits available and be able to show they are complied with (FSA56, 58).

Conduct regular water risk assessments, carrying out analysis for chemical, microbiological and mineral content, maintain a record of the results of any analysis (FSA53, 58, 59).

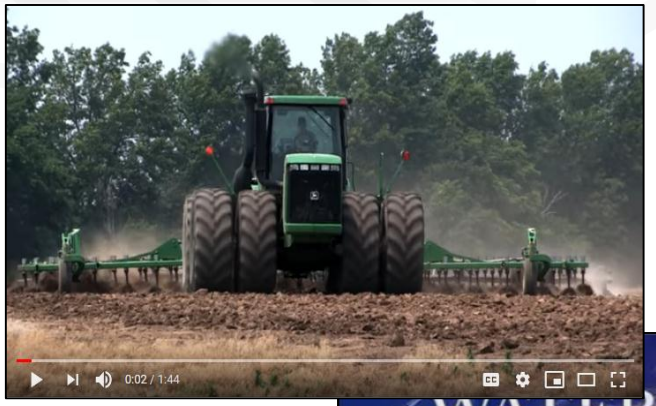
Show evidence that if the test results from a water risk assessment are outside tolerable limits, treatment is undertaken to manage water quality (FSA53).

Keep records to show you manage input applications and other farm operations to reduce the risk of polluting the environment (FSA60, 61).

Show you have established buffer zones close to water to prevent pollution and erosion (FSA61).

Water Pollution Management

USDA: Preventing runoff into the Mississippi River



Department of Environment and Science, Queensland Government, Australia: Preserve the wonder, reducing fertiliser run-off

Jackson Soil & Water Conservation District, Oregon, USA: Agricultural water quality and you

Further reading and examples:

- FAO: Water quality management and control of water pollution
- FAO: Water pollution from agriculture: a global review
- Global Food Security Programme: Agriculture's impacts on water quality
- Agriculture and Agri-Food Canada: Agriculture and water quality

Optimised irrigation method

Best practice :

Irrigation methods used balance farm economics and water efficiency for optimum performance.

The method of irrigation optimises the irrigation system, based on water sources, local conditions, regulations and laws, results of soil assessments, and the theoretical needs of the relevant crop.

FSA55 If you irrigate, do you have a management plan to optimise water usage, quality, and availability and to reduce waste water?

FSA57 If you irrigate, do you use an optimised irrigation method?

Optimised irrigation method

Optimised irrigation is used to determine the correct frequency and duration of watering. It enables the correct amount of water is applied at the right time, increasing your irrigation efficiency without compromising agricultural yield. Poorly managed irrigation systems can cause soil damage, environmental problems, and contribute to low water use efficiency.

By understanding your soil, monitoring the soil moisture content, evaluating rainfall patterns (to determine timing, quantity and quality) and understanding crop development the amount of water used can be regulated to minimise water stress and maximise yields.

The application of precision irrigation technologies (making use of a wireless sensor network to specifically match soil and plant status and water needs) is a high-tech approach to ensuring the amount of water applied closely matches the crop requirement. However, it does not need to be high tech. It could be understanding water requirements by testing for soil moisture deficit, using the most appropriate equipment for irrigation and using an irrigation scheduling method or service to apply the correct amount of water.

Optimised irrigation method

More water does not always equal more yield.

- Consider economics; does a practice result in greater profit?
- Grow alternative crops that need less water
- Use prime acclimation to prepare plants for drought
- Use technology to optimise schedules: soil moisture sensors, smartphone apps
- Monitor soil moisture between irrigations to help optimise water use
- Select the most efficient, but affordable, irrigation system
- Maintain the irrigation equipment to prevent leakage
- Use weather forecasts to time irrigation and minimise evapotranspiration (water loss to the environment affected by humidity, temperature, wind, and soil moisture)
- Avoid over-irrigation which can cause:
  - waterlogging;
  - run-off from land, leaching nutrients ;
  - increased salinity;
  - poor root formation.

How to answer YES

Show that in scheduling irrigation you take into consideration:
- water source;
- results of soil assessments;
- theoretical needs of the crop;
- weather conditions;
- timing of irrigation to avoid unproductive losses at times of high evapotranspiration;
- use of appropriate irrigation equipment (FSA55, 57).

Show that in scheduling irrigation you consider all relevant laws and regulations (FSA55, 57).

Show that in scheduling irrigation you regulate the amount of water used to minimise water stress whilst ensuring irrigation water is not over-applied (i.e. above field capacity level) unless deliberately done to avoid salinisation (FSA55, 57).

Show that in planning water use you consider the needs of the community (FSA57).

Show that you recycle and reuse water where possible (FSA57).

Show that you optimise your irrigation system design and performance to enhance your control and management of the irrigation system more efficiently during its operation (FSA57).

Optimised irrigation method

Recording water use

Every farmer should keep a basic irrigation record. This should include the date of irrigation, the total area irrigated, the type of irrigation, the quantity and the source. If it is not possible to know the quantity, record the length of time the irrigation was on.

Field	Date	Location field or house	Area (when used in the field) (e.g. hectares or acres)	Type of irrigation	Quantity used (e.g. litres or gallons)	Operator	Source
1							
2							
3							
4							

Further reading and examples:

KWL, Canada: Farm Water Planning Toolkit

Defra, UK: Managing water better

Environment Agency (UK): Waterwise on the farm

Clean water 3