

ISSUES IN

IRRIGATION MANAGEMENT

FOR THE QUEENSLAND

HORTICULTURAL INDUSTRY

*Working
towards best
management
practice*



*Explanatory
Notes
for Self
Evaluation
Workbook*

Version 2.0

About this booklet

This “Explanatory notes” booklet is designed to assist growers working through the “Self Evaluation Workbook” in this series. This series of booklets are designed to assist growers identify opportunities for increased profitability and sustainability within their existing irrigation practices. Issues are raised as a means to enable irrigators to:

- (a) evaluate their current irrigation activities and performance; and***
- (b) identify practices to improve their irrigation management.***

The aim of this manual is to increase the profitability of irrigation practices and encourage more efficient and cost-effective use of irrigation resources.

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Colorado State University Cooperative Extension Service

DNR (1984). Farm water supplies design manual. Department of Natural Resources, Brisbane.

National Centre for Engineering in Agriculture, Toowoomba.

Primary Industries and Resources South Australia.

Southern, N. (1997). Farm Irrigation: Planning and Management. Inkata Press, Melbourne

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Why Irrigation?

Water is a major input resource in all horticultural operations. Irrigation management practices have the potential to strongly influence both the quantity and quality of crop produced. In many cases, water is both a limited and limiting resource to horticultural production. However, the ability to irrigate does not automatically guarantee profitability and long-term sustainability of horticultural farms. Inappropriate or inefficient irrigation practices may lead to crop stress, disease and/or loss, as well as groundwater and surface water contamination, erosion or salinity problems.

What is Best Practice?

The measurement of current performance and the identification of practices to improve performance is commonly regarded as a “best practice” process. It is not expected that your irrigation system will be perfect. However, this manual is designed to assist you identify areas where you may be able to make improvements and increase profitability.

Specific best practices for irrigation management will vary between farms depending on a wide range of factors. Hence, it is necessary for individual growers to identify their own best practices. This is normally achieved through benchmarking existing performance and working towards continual improvement.

What's Involved?

The approach adopted in this workbook may be simply summed up by the adage "*if you aren't measuring it, then you can't manage it*". This workbook should help you identify the factors which may be affecting your irrigation performance as the first step to better irrigation planning and management.

Is this Process Compulsory?

No. This workbook has been developed to assist you identify irrigation issues which could be affecting your profitability or sustainability. Participation is entirely voluntary and for your own benefit. There is no expectation that your scores or responses will be publicly reported.

What are the Benefits?

Increased profitability and sustainability are the major benefits of improved water management. However, voluntary adoption of BMP processes will also help ensure the most effective use of the water resources, reduce environmental impacts of irrigation, improve public perception of the horticultural industry and reduce the need for regulation or mandatory controls in the future.

What's in this Booklet?

This booklet provides a brief overview of the major factors influencing the performance of irrigation practices. It also provides the background information required to answer each of the questions asked in the “Self Evaluation Booklet” in this series and provides recommendations for additional reading in each topic area. However, you should note that the information provided in this booklet is necessarily limited in scope and further assistance should be sought before making investment decisions.

Additional information can also be obtained from the QFVG *Water for Profit* Workshop Booklets and Information Sheets or by contacting your local *Water for Profit* field officer via the QFVG members access line on 1800 654 222 or on the Web at www.qfvg.org.au.

WATER RESOURCES

Water is a key requirement for the production of high quality fruit and vegetables. However, it is commonly a limiting resource and like all farm resources, should be managed to ensure the greatest return on the asset. While many farmers would like “more” water to be made available to increase reliability or production volumes, the primary focus of this document is making the most of your existing resource. This can only be achieved through an understanding of the physical resource constraints (ie. the total volume available, rate of extraction and other access limitations) and the capability of your on-farm infrastructure to adequately store, deliver and apply water around your farm in response to your crop requirements. The questions in this section focus on the broad issue of water availability and capacity at the farm scale and the ability of your irrigation system to meet the crop water requirements.

Qn1: Do you have enough water for your cropped area?

An important factor in effective irrigation is the capacity of the system to supply the total seasonal crop water use. This requires a knowledge of the expected crop water use for the whole season as well as a knowledge of the irrigation supply, storage, distribution and application system capacity to apply the required water.

There are many factors which influence the amount of water used by crops. One obvious factor is climate and it is self evident that crops will require more water on hot or windy days. However, other factors affecting crop water use include location (due to localised effects on humidity, wind, radiation, and exposure), canopy cover and crop stress. Seasonal influences on water use at the farm scale include the water requirements of the individual crops planted, growth stage, length of the growing season of the crops and the area of crop planted.

Unfortunately, the variability of seasonal weather patterns often makes it difficult to predict the total seasonal water available. However, the worst case occurs during major droughts. Hence, it is necessary to decide if your irrigation system must be able to cope with extended periods of drought. If so, the supply of water must be extremely reliable, and the capacity of the equipment used to distribute and apply the water around the farm must be adequate. During average or wet years, the system will not be working to its capacity. An alternative is to design for a lesser capacity, and accept that there will be a yield loss that is likely during extreme dry periods. Factors which influence the decision include:

- capital and operating costs of the alternatives;
- the likelihood, amount and value of the yield reduction; and
- the reliability of the water supply.

Information Sheets Available

- [*Estimating crop water use based on evaporation measurements*](#)

Qn 2: Can you deliver enough water to meet the peak crop water requirement?

The irrigation system must be able to cope with the period of maximum crop water requirement. An inability to apply sufficient water during hot, dry periods will severely affect the quality and quantity of many horticultural crops. Hence, both the rate of water supply and the irrigation infrastructure (eg. pumps, pipelines) should be designed and selected to meet the maximum daily crop water use requirement. Factors influencing the peak crop water requirement are similar to those raised in question 1 above.

Information Sheets Available

- [*Estimating crop water use based on evaporation measurements*](#)
- [*Scheduling calculation sheets*](#)
- [*Estimating how much water should be applied*](#)

Qn 3: Do you have a strategy in place for managing periods of limited water availability?

It is not uncommon for irrigated farms to suffer periods of limited water availability. Irrespective of the confidence which you place in your water reliability, it is appropriate that you consider alternatives for periods of limited water availability. Common reasons for limited water availability include: drought or expected rains failing to eventuate, planted crop areas being too optimistic for the water available, declines in the level of the groundwater table reducing pumping capacity, irrigation equipment failure and water storages leaking or rupturing. Alternative strategies that could be considered during periods of limited water availability include:

- Obtaining additional capacity from alternative sources (eg. from neighbours, rarely used bores or digging in river beds);
- Reducing irrigation application volumes or increasing irrigation intervals (most appropriate on soils with a high available water content and crops with well developed root systems);
- Changes in the application system used (eg. using temporary drip tape rather than overhead spray);
- Selecting crops (or varieties) which are capable of withstanding some drought stress; and
- Sacrificing a portion of the cropped area by reducing irrigation to it and hence, making more water available for the remainder (eg. not irrigating older trees, reduced irrigation on less profitable crop varieties or planted areas; reduced irrigation in less efficient areas of farm).

Qn 4: Do you have a water management plan or strategy?

As irrigation is a large investment and decisions are made which influence returns over both the short and long term, it is appropriate that some form of planning is implemented to maximise the returns from your irrigation practices. An appropriate plan should consider all aspects of the resource availability (including compliance with licencing conditions), current and future infrastructure requirements, current and future crop requirements, as well as the day-to-day management practices and maintenance requirements of the irrigation system. The plan does not necessarily need to be written down in a formal document, but should include the following:

- predictions of crop demand/water use;
- planting area and planting dates;
- soils and topography map of farm including location of water sources or supply points;
- irrigation scheduling strategy;
- availability and usage requirements of irrigation equipment;
- labour requirements;
- contingency plans for breakdowns (availability of replacement gear, periods for maintenance /repairs, catch-up requirements);
- infrastructure replacement or future development requirements;
- a regular process to identify any major threats to continued access either due to physical changes or legislative changes; and
- future cropping land/farm development requirements.

IRRIGATION INFRASTRUCTURE

Infrastructure associated with irrigation commonly represents one of the largest on-farm capital investments by growers. However, in many cases, infrastructure is installed with little reference to future irrigation requirements or specification of minimum levels of performance. This section provides questions regarding the appropriateness of the infrastructure components given the crop production requirements and the operating performance of the components and prompts the irrigator to consider the maintenance requirements of the individual infrastructure components.

On-farm Pumping, Storage and Distribution Systems

Qn 5: What are your energy costs associated with irrigation pumping?

For many farms, the costs associated with irrigation pumping are a significant component of production costs. It is not uncommon to find that many irrigation pumping plants are using up to 40 percent more fuel than necessary compared to if a properly sized, adjusted and maintained pumping plant were used. Hence, evaluating your pumping costs is one way of determining if your system is operating efficiently. The total irrigation fuel or energy bill is composed of two parts. The first is related to pumping plant performance and the second to crop and irrigation management.

$$\text{Total fuel bill} = \frac{\text{Pumping Cost/Volume} \times \text{Volume Applied}}{\text{Volume Applied}}$$

Reducing the total volume applied reduces the fuel bill proportionately. Hence, if the amount of water applied is minimised through appropriate irrigation scheduling and high application efficiencies, the fuel bill will also be reduced by a similar amount. However, the major factors that influence the pumping cost per volume are: pumping plant efficiency and total dynamic head (TDH), which is the total hydraulic resistance against which the pump must operate. Common causes of high costs per unit volume include:

- Poor pump selection.

- Worn-out pumps
- Improperly sized engines or motors.
- Engines in need of maintenance and/or repair.
- Improperly matched gear heads.

Target levels of pumping cost per volume are:

Cost	Electric	Diesel ^a
High	>45c / ML / psi >6.5 c / ML / kPa	> 65 / ML / psi >9.4 c / ML / kPa
Moderate	25-45c / ML / psi 3.6-6.5 c / ML / kPa	50-65 c / ML / psi 7.3-9.4 c / ML / kPa
Low	<25c / ML / psi <3.6 c / ML / kPa	< 50 c / ML / psi <7.3 c / ML / kPa

^a at 46c/litre

Qn 6: How efficient is your on-farm storage?

The main storage performance indicator is storage efficiency which is largely dependent on the extent of seepage and evaporation from the storage., inaccessible storage volumes (due to location of outlets above the lowest point in the storage) or storage failures. However, the ability of the farm infrastructure to capture and store both rainfall run-off or riverine flows when they are available is also a key aspect of storage performance.

Water storages with large surface areas and shallow water are likely to lose large amounts of water (up to 50% of the total water stored) through evaporation, particularly during summer months. Storages located on, or constructed with, permeable soils can lose significant amounts of water through seepage. In addition to causing the loss of valuable water, seepage has the potential to cause local waterlogging. Calculating the storage efficiency requires either a measure of the storage inflows and outflows, and/or for the volume of the storage to be regularly monitored. Target levels of storage efficiency performance are:

Poor	<70% efficiency
Satisfactory	70-80% efficiency
Good	80-90% efficiency
Excellent	>90% efficiency

Information Sheets Available

- ☒ *Pump efficiency: factors and costs*
- ☒ *Reading engine performance curves*
- ☒ *Reading pump performance curves*

Qn7: How efficient is your on-farm water distribution system(s)?

The efficiency of water distribution around horticultural farm is typically high due to the extensive use of piped systems. However, where channel systems are used, water losses may occur due to either evaporation or seepage. Where pipes are used for distribution, significant leakages may also occur due to broken or aged pipelines or problems around joints and fittings. It is normally difficult to directly measure the magnitude of individual leaks and it is more common to assess leakages over the entire pipe line by using meters at both the pump and field end of the pipes. Target levels of performance are:

Poor	<90% efficiency
Satisfactory	90-95% efficiency
Good	95-98% efficiency
Excellent	>98% efficiency

Qn 8: What is the current physical condition of your on-farm pumping, water storage and distribution system(s)?

Service problems with farm pumping equipment are not only an inconvenience, but can contribute to loss of production. An efficient farming operation depends upon trouble-free pumping. Time and energy savings can also be made by keeping pumping equipment in good working order. Maintenance levels vary depending on the complexity of equipment and the consequence of failure. Pumps do not normally require a high degree of maintenance and the majority of faults can be readily rectified. However, at times there will be problems which you may not be able to fix. If you cannot identify the problem, you should consult your supplier or the pump manufacturer. Typical signs that you have a maintenance problem include:

- Pump shaft hard to turn;
- Heat – in bearings and glands
- Pump will not start;

- The flow drops off or stops completely;
- Pump pressure decreases;
- Energy/Fuel usage increases;
- Pump vibration – an increase could indicate problems;
- Excessive wear;
- Leakage of water, oil or grease; and
- Excessive noise (could be due to cavitation or bearings).

Regular inspections and preventative maintenance of the storage system will help detect leaks and inefficiencies in the system before they become serious. Storages should be checked for signs of significant deterioration including erosion, slumping, cracks or rilling. Boggy areas alongside storages may indicate seepage. Particular attention should be paid to new storages being filled for the first time.

Regular inspections and preventative maintenance of the water distribution system will help detect leaks and inefficiencies in the system before they become serious. Pipes should be checked for signs of deterioration including corrosion, joint stresses and pipe wear. Distribution channels should be checked for signs of deterioration such as bank erosion, slumping, cracks or rilling. Boggy areas around pipes or channels may indicate leakages.

In-field Application System

The type of irrigation system will often be selected according to personal preference, but soil types, crop types and environmental conditions should also be taken into account. Irrigation systems should be designed according to accepted hydraulic principles, taking contours into account. Incorrectly designed systems will result in uneven outputs from emitters across the irrigation system. In the case of sprinkler systems, the uniformity of distribution of water between emitters is also important and should be thoroughly investigated before installation.

Selecting an appropriate application rate for the irrigation system is also important.

Evaporation can rob a significant proportion of the water before it hits the ground if the application rate is too low. Runoff will result if application rates are too high and exceed the capacity of the soil to absorb water (ie. infiltration rate). Application rate can be immediately compared with the readily available water content of the root-zone, to determine the approximate irrigation run time required to refill the soil moisture store. It is recommended however, that soil moisture monitoring equipment be used to fine tune irrigation management, including the appropriate irrigation volume for each irrigated area.

Qn 9: Is your application system(s) operating at the design pressure in the field?

All irrigation application systems are designed to be operated within a narrow range of system pressures. If the system is operated outside of this pressure range, the discharge from the emitters will vary from the design application rate. For spray systems, the distribution of the spray pattern, degree of water droplet breakup and the uniformity of application will also be greatly affected by variations in nozzle pressures. Where the system is subjected to either pressure fluctuations during the irrigation event, or variations in pressure within the application system, the performance of the irrigation decreases due to variations in discharge and uniformity of application. Target levels for the pressure variations within the application system are:

Score 2	<i>Operating at >10% away from the design pressure</i>
Score 3	<i>Operating within ±10% of design pressure but with large in-field variations</i>
Score 4	<i>Operating within ±10% of design pressure with minimal in-field variations</i>





Qn 10: How evenly does your system apply water within the field?

The evenness or uniformity of irrigation water application is a critical determinant of both the irrigation efficiency and the profitability of irrigation practices. The

ability to irrigation evenly affects crop germination, seedling development rates, and the water stress applied to individual plants during the growing periods. In any irrigation, one half of the field has received less than the average applied over the whole field while the other half has received more than the average applied. Hence, if the average volume applied is the amount needed to meet the crop requirements, one half of the field has been over-irrigated (ie. reducing the efficiency of the application) while the other half of the field has been under-irrigated (ie. suffers higher crop stress and reduced yield). Thus, a major aim of irrigation management should be to apply water with a high degree of uniformity while keeping wastage to a minimum. Target levels of in-field distribution uniformity are:

	High pressure spray	Drip, micro-spray & low pressure spray
Large variation	<75%	<85%
Some variation	75-90%	85-95%
Little or no variation	>90%	>95%

Information Sheets Available

-  *Catch can trials – big guns*
-  *Catch can trials – hand shift and solid set systems*
-  *Catch can trials – centre pivots*
-  *Catch can trials – lateral moves and low pressure booms*

Qn 11: Do you know the rate of water applied by your system?

Efficient and effective irrigation requires the ability to accurately apply a desired volume of water to the crop. This in turn requires an accurate knowledge of the rate of water application by the irrigation system. The level of accuracy required can normally only effectively be achieved through direct measurement of the discharge rates under operational conditions. While discharge may be

nominally provided by suppliers and dealers, the use of inappropriate operating pressures, blockages, pipe and nozzle wear, as well as system maintenance and operating conditions may all affect the discharge for the system.

Qn 12: How efficient is your application system(s)?

Water application efficiency refers to the amount of irrigation water that becomes available to the plants root zone, as a percentage of the water that is applied by the irrigation system. In this context, application efficiency is reduced by the loss of water through factors including:

- wind blowing spray droplets away from the site;
- evaporation, of droplets in the air and of free water lying on plant and soil surfaces;
- run-off, when application rates exceed the soil infiltration rate; and
- deep percolation, where irrigation water drains below the root zone, and there is no later possibility of root growth extracting it.

Poor application efficiencies are a contributor to over watering which can exacerbate waterlogging and salinity problems. Target levels of application efficiency are:

Low	<i><75% efficiency</i>
Acceptable	<i>75-90% efficiency</i>
High	<i>>90% efficiency</i>

Qn 13: What is the current physical condition of your application system(s)?

Irrigation application systems are similar to all other components of farm machinery and infrastructure in that they require regular inspections and preventative maintenance to ensure that they continue to operate efficiently. The level of maintenance required will depend on the nature of the application system. However, even with effective maintenance, all irrigation application systems will have a finite life expectancy which should be considered in future planning. Application system components which should be routinely checked include:

- emitter operation and blockages;
- nozzle wear;
- noisy/defective valves;
- pipe and joiner leakages/breakages;
- effectiveness of the filtration system; and
- operation of electrical, mechanical and hydraulic equipment.

Information Sheets Available

- ☑ Micro-system sprinkler checks*
- ☑ Drip line maintenance: chlorination*
- ☑ Drip line maintenance: line flushing*
- ☑ Recommended practice – acid treatment*
- ☑ Recommended practice – filtration*
- ☑ Recommended practice – water quality*

IRRIGATION MANAGEMENT

The performance of any irrigation system is largely determined by the manner in which the system is operated. The level of plant water stress suffered by crops is a direct function of when, and how often, the irrigation system is turned on. Similarly, the efficiency of the irrigation is largely a function of how much water is applied during each irrigation event. Hence, operational management issues significantly affect the profitability and efficiency of irrigation. This section raises questions designed to assist with the identification of appropriate strategies for irrigation scheduling (both when to irrigate and how much to irrigate), modification of irrigation practice in response to external influences (eg. weather conditions and water quality).

Qn 14: Do you measure, record and compare (ie. benchmark) crop yield/ quality/returns and the volume of water applied?

Benchmarking is an effective way to identify practices and opportunities to improve irrigation management. To benchmark irrigation practices, growers simply need to measure how much irrigation has gone on to the crop and know the total or marketable crop yield. Comparisons between water use and yields can be made either between fields on the same farm or between farms at a regional scale. Large variations between fields and growers are common with the differences observed helping to identify more appropriate management practices.

Information Sheets Available

 *Benchmarking water use*

Qn 15: Do you use an irrigation scheduling tool to modify irrigation applications?

Appropriate irrigation scheduling, based on timely measurements or estimations of soil moisture content and crop water needs, is one of the most important requirements for irrigation management. Scheduling involves the identification of both the

appropriate time to irrigate as well as the appropriate volume of water to apply. A number of devices, techniques, and computer aides are available to assist producers in determining when water is needed and how much is required. Producers should choose the scheduling method which best suits their needs and management capabilities. Regardless of the method used, some on-site calibration and the appropriate location of the sensor in an area of the field which is representative of both the is water application and the crop extraction is essential. Many producers find that irrigation services offered by crop consultants are the most cost-effective method of scheduling and managing their water.

Irrigation scheduling uses a selected water management strategy to prevent the under or over-application of water while maximising net return. In a sense, all irrigations are scheduled, whether by sophisticated computer controlled systems, water availability, or just the irrigator's hunch as to when water is needed. Experienced producers know how long it takes them to get water around their farm and are proficient in avoiding crop stress during periods of average rainfall. The difficulty lies in applying only enough water to fill the effective root zone without unnecessary deep percolation or runoff. Proper accounting for crop water use ensures optimal crop production quality and provides producers with the knowledge of how much water should be applied at any one irrigation event.

Irrigation scheduling tools

Subjective Tools	Objective Tools
Finger Shovel Push rod	Tensiometric sensors (eg. tensiometers, gypsum blocks, watermark) Capacitance sensors (eg. enviroscans, c-probe, gopher, buddy, diviner) TDR systems (eg. growpoint, trace, hydrosense) Neutron moisture meter Weather station Evaporation pan

Information Sheets Available

- [*1* Weather stations](#)
- [*1* Comparison of scheduling tools](#)
- [*1* Choosing a soil-water monitoring tool](#)
- [*1* Positioning of soil-water monitoring tools](#)
- [*1* Tensiometers in irrigation](#)
- [*1* Interpreting soil moisture data](#)

Qn 16: How well do you match your irrigation interval and volume applied with the crop requirements and soil limitations?

The decision to irrigate should be based upon an estimate of crop and soil water status, coupled with some indicator of economic return. Appropriate scheduling should enable producers to maximise profitability while reducing the traditional number of irrigations, thereby conserving water, labour, and plant nutrients. Effective irrigation scheduling requires a knowledge of the:

- soil water-holding capacity;
- appropriate placement and calibration of the scheduling tool;
- current available soil moisture content;
- crop water use or evapotranspiration;
- crop sensitivity to moisture stress at current growth stage;
- irrigation and effective rainfall received;
- availability of water supply; and
- length of time it takes to irrigate a particular field.

Information Sheets Available

- [*1* Soil water and texture](#)
- [*1* How much water is in my soil?](#)
- [*1* Choosing a soil-water monitoring tool](#)
- [*1* Positioning of soil-water monitoring tools](#)
- [*1* Tensiometers in irrigation](#)
- [*1* Interpreting soil moisture data](#)
- [*1* Estimating how much water should be applied](#)
- [*1* Converting readily available water to hours of irrigation – drip systems](#)

Qn 17: Are your irrigation practices coordinated with other farming system operations?

Irrigation is only one of the many management issues which need to be considered within an effective farm management structure. As such, there are many instances where growers need to make decisions which involve trading off the conflicting demands of the various farm management units. In many cases, cultivation, fertigation, and/or harvesting requirements may influence irrigation practices. It is also not uncommon for crop pest or disease treatment to be required at about the same time as irrigation water would ideally be applied. In these cases, the irrigation application may reduce the ability to apply the pesticide within the field. Similarly, to apply the pesticide and then irrigate immediately may reduce the effectiveness of the pesticide and potentially contribute to pesticide movement off-site either in surface run-off or deep drainage water. Hence, because of the potential impacts on farm profitability and sustainability, there is a need to coordinate the various farming activities to optimise the deployment of farm resources.

Qn 18: Do you modify your irrigation application in response to weather conditions?

The performance of irrigation application systems is often affected by the weather conditions under which the system is operated. For example, operating spray systems under windy conditions results in greater spray drift (affecting the uniformity of application) and greater evaporative losses. Similarly, irrigations conducted during the hottest part of the day typically result in greater evaporative loss than operation at night. While it is difficult and rarely cost effective to modify irrigation practices with every change in the weather, some typical modifications to irrigation practice include:

- switching off spray irrigation due to high wind conditions;
- for travelling guns, using tapered nozzles rather than ring nozzles when operating under high wind conditions;
- for high pressure spray irrigation, reducing nozzle spacings under high wind conditions;

- irrigating at night during high evaporative periods;
- reducing the irrigation volume applied or the timing of irrigation in response to rainfall events; and
- modification of irrigation strategies due to either daily or long term weather predictions (eg. SOI) where these are reliable.

Qn 19: Do you manage your irrigation and soils to maximise moisture storage and minimise evaporation losses?

Various crop management strategies can be used to stretch limited water resources and ensure that water applied by both irrigation and rainfall are stored and used effectively by the crop. Common practices include the use of:

- fallow periods to store pre-season soil moisture;
- mulches (both organic and plastic) to reduce evaporation losses from the wetted soil surface and reduce the use of water by weeds;
- controlled traffic or minimum cultivation practices, and/or the use of organic and mineral amendments to improve soil structural properties, increase infiltration and improve crop rooting volumes;
- irrigation at night to reduce losses due to evaporation and wind drift.

Qn 20: Do you have surface water run-off due to irrigation practices?

Surface water run-off due to irrigation commonly occurs where the rate of water application exceeds the soil infiltration rate. Localised run-off within fields occurs due to non-uniformity problems associated with irrigation application. However, localised run-off typically results in little or no loss of surface water from the field area. Where irrigation application produces significant surface run-off from the field, this normally indicates the rate of water applied by the system greatly exceeds the soil infiltration rate. Rainfall during or immediately after irrigation may also contribute to significant surface water run-off. In all cases, the run-off water may contribute to the movement of sediment, pesticides and nutrients from the field and into local waterways. Strategies to reduce surface run-off include:

- reducing the rate of irrigation water application;
- reducing the nozzle size for fixed spray systems;
- reducing the period of individual irrigation events;
- applying the water as a series of pulses; and
- reducing or stopping the irrigation in the event of significant rainfall.

Where water run-off is still likely to be a problem, consideration should be given to the construction of grassed waterways, reticulation systems, dams and artificial wetlands to capture and reduce the impact of surface water run-off.

IRRIGATION SUSTAINABILITY

Inappropriate irrigation practices have the potential to produce significant environmental impacts which could affect both farm profitability and viability as well as degrade the land and water resources of surrounding areas. Hence, it is appropriate that both on-farm and off-farm impacts of irrigation infrastructure and practices are regularly assessed with a view to minimising any long term environmental effects. This section raises questions regarding the potential for groundwater fluctuations, surface water run-off, sediment movement, potential root zone salinity buildup and soil structural degradation.

Qn 21: Is your ground water table changing due to irrigation practices?

Irrigation practices have the potential to influence groundwater tables through either excessive extraction of water or by the application of excess water resulting in deep drainage below the crop root zone and groundwater rise. It should be noted that the groundwater fluctuation may be first noticed off-site. While the depth to the groundwater table can be measured directly, there are a range of external indicators of groundwater movement. Signs of groundwater table falls include: reduced pumping capacity, natural swamps or seepage points start to dry up, local river levels decrease and decreases in the quality of groundwater. Signs that the groundwater table is rising include: low lying areas start to become increasingly boggy, seepage increases in either low areas, slope interfaces or into stream beds and the crop starts to suffer the effects of waterlogging and/or salinity.

Qn 22: What is the quality of water used for irrigation?

Many natural waters contain impurities which may be directly harmful to crops, affect the soil structural conditions or affect the wear and performance of the irrigation system. Crops vary in their ability to utilise poor quality water and the effect of specific ions may vary greatly between crops. Similarly, the performance and

requirements of each irrigation application system used may be affected by the water quality (eg. filtration required for sediment when using micro-irrigation systems). The main criteria for assessing irrigation water quality include:

- Total salts;
- Sodium content;
- Residual alkali;
- Specific ions (typically boron, chloride, sodium, iron);
- Sediment/solids content; and
- pH.

Qn 23: Do you have salinity problems in the crop root zone?

Leaching excess salts which are carried by irrigation water is necessary in some soils to avoid salt accumulation in the root zone. This is most likely to become a problem where saline water is used for irrigation and salt sensitive crops are grown. The leaching requirement can be calculated fairly precisely as a function of soil and water salinity. However, most irrigation systems in Queensland do not achieve efficiencies that warrant the addition of a leaching fraction. Most coastal areas of Queensland also regular receive leaching rainfall events which reduce the risk of root zone salt build up. Where it is necessary, approximately 5 to 10% of total water should be applied annually to leach soluble salts from the crop root zone. In these cases, the leaching should be undertaken when soil nitrate levels are low and crop N needs have been satisfied. Soils should never be intentionally leached within 72 hours after the application of any fertiliser or pesticide.

Information Sheets Available

[!\[\]\(da54fa747b6713d79175de3c1d218b58_img.jpg\) Salts in the crop root zone](#)

Qn 24: Are you experiencing cropping or irrigation problems associated with soil structural degradation?

The soil structure in the crop root zone has a significant effect on the development of surface crusts, crop emergence rates, the

availability of soil water for crop uptake, the ability of plant roots to penetrate and access nutrients, the infiltration rate of water into the soil and the drainage rates of water out of the soil profile. Soil structure can be significantly degraded through the use of inappropriate cultivation and irrigation practices, decreases in organic matter content or the use of poor quality irrigation water. Typical signs of soil structural problems may include increases in surface run-off from irrigation, waterlogging in the crop root zone, plants exhibiting symptoms of nutrient disorders, increases in plant disease rates, and the failure of crops to emerge or develop significant root growth.

Qn 25: Do you have erosion associated with your irrigation practices?

The loss of soil through erosion poses a significant threat to the long term profitability and sustainability of farming operations. The surface soil, which is most commonly lost by erosion, contains the majority of the soil organic matter and nutrients required by the crop and is typically the best structured of the soil horizons. The decrease in the depth of the soil may also affect the crop root zone depth and reduce the total volume of readily available water held in the soil profile.

Erosion may be accelerated by irrigation practices via surface water run-off

associated with excessive water application rates or the application of water during or immediately prior to a significant rainfall event. However, erosion may also be facilitated within the field by irrigation practices, cultivation practices or cultural practices which concentrate the flow of water. For example, tow-paths for travelling irrigators may concentrate overland flows. Similarly, the construction of crop beds may channel irrigation and/or rainfall water resulting in localised erosion. Inevitably, erosion causes silting, either on-farm or off-farm which may need to be corrected.

The design and installation of irrigation infrastructure may also contribute to erosion in non-irrigated areas. For example, the location, design and installation of channels, pipelines and pumping stations may all contribute to localised erosion, particularly where bare soil is exposed for extended periods. Practices to reduce erosion include:

- mulch bare surfaces;
- minimise periods of exposed bare soil;
- reduce surface run-off from irrigation and rainfall events;
- field layout;
- grass drainage lines, waterways and field surrounds; and
- construct artificial wetlands to capture and reduce the impact of sediment loss.

***For more information,
contact your local QFVG
Water for Profit Field Officer,
or ring the
QFVG members hotline on
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