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Centre pivot irrigation in the Riverina

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- **Will this technology suit your farming operation?**
- **Will it increase your profitability?**
- **Pre-purchase considerations.**

This Primefact is designed to give you a better understanding for making an informed decision about a large financial commitment.

Introduction

The past few years have seen a rapid increase in the number of overhead irrigators being operated in southern New South Wales (Murray and Murrumbidgee valleys) as part of farmers' push to increase profitability through increased water use efficiency and accurate application.

There is little doubt that centre pivot irrigation systems are capable of giving high returns per megalitre (ML) of water applied (particularly with winter cropping in the Riverina), but these high returns are only possible if crop agronomy and water management practices are of a high standard.

The advantages of improved irrigation management and lifestyle (lower labour requirement) and reduced risk of crop failures compared with surface systems are paid for with higher energy and capital costs.

Unfortunately there are some who have invested large sums of money only to find that the system costs more to run than they had anticipated and the machine does not return the benefits they expected. Operational problems, usually due to lack of experience, add insult to injury.

An overhead irrigation system's maximum water delivery rate is effectively set and is only able to irrigate adequately a specific area. A common reason for growers complaining about their machine's performance is that they have over committed the machine to too large an area, that is, too many circles. When crop water use is at its peak the machine simply cannot keep up with demand and the crop does not reach its potential.

Issues of concern discussed in this Primefact include soils, infiltration, design, cropping options, friction and pressures, capital and running costs, power requirements and calculations, tree clearing and on-farm water storage.

Experienced operators of these machines are a valuable source of practical operational information. They should be consulted (within the bounds of friendship) to help avoid making (often expensive) mistakes.

Note

In some sections pounds per square inch (psi) and US gallons per minute are used as units of pressure and flow rate where equipment is manufactured in countries using US or Imperial systems (specifically nozzles and pressure regulators).

Some useful conversion factors:

9.8 kPa = 1 m

6.9 kPa = 1 psi

1 psi = 0.7 m

1 ML/day = 11.57 L/s

1 US gallon per minute (GPM) = 0.0638 L/s

1 L/s = 15.85 US GPM

1 bar = 14.714 psi = 101.53 kPa = 10.36 m

Pros and cons of centre pivot irrigation

Pros

- Precise control of irrigation application
- Low labour requirement
- Low (not 'no') maintenance (no more than any farm machinery)
- Long life (>20 years depending on water quality)

- Low risk of crop failure through waterlogging (when risk of long-term waterlogging is too high to allow surface irrigation)
- Allows irrigation outside surface-irrigating season when coupled with an on-farm storage (can apply small amounts in dry winter periods)
- Allows irrigation of undulating country
- Allows irrigation of light textured and leaky soils
- Towable machines can be used to grow multiple circles of winter crop (lowers capital cost per hectare)
- Room in the soil to store some water from rain during/after irrigation (soil profile not saturated by irrigation)
- Surface drainage works are (usually) a minor expense
- Lifestyle (no chasing water in the middle of the night)

Cons

- Often higher initial capital cost than for surface irrigation
- Higher pumping costs than for surface systems (reduced labour paid for with higher energy cost)
- Application rate and machine area/length limited by soils' instantaneous infiltration rate (IIR)
- Prone to high evaporation in summer and in windy weather
- Can be expensive to run when growing summer crops (high volumes of water at high pumping cost)
- Trees must be removed
- Certain soils will not wet after initial irrigation due to sealing and are unsuitable
- Serious wheel tracking and rutting problems can occur on poorly drained soils

There is no definitive ‘best option’ for the machine you choose. Factors which must be considered include:

- soil type(s)
- type of crops you wish to grow and profitable yield levels
- area available, number of circles and configuration
- size of circle(s)
- supply pipe sizes and distances pumped
- diesel/electric pumping
- hydraulic/electric ground drive
- cost per megalitre on the paddock
- climatic factors (peak ET_o (evapotranspiration) and long-term averages for your area)
- water availability and reliability—can your supply keep pace with the machine?
- water quality
- potential for on-farm storage
- capital costs
- running costs.

How much you are prepared to pay for lifestyle change / convenience of operation, improved risk management and other benefits is, of course, your personal choice.

Siting and soils

Centre pivot irrigators are suitable for many of the soils in the Riverina of NSW. A major advantage is that they are able to traverse undulating country, common in areas of lighter textured soils. These soils are less suited to surface irrigation because of their high porosity and prohibitive cost of land forming (both in earthworks volume and structure damage). They have high production potential under spray irrigation.

One circle—one soil type

Try to site each circle on one soil type. If there are two soil types under one circle then irrigation and agronomy will be compromised on either one or both, and average yield will suffer. Machine tracking problems, bogging, wheel ruts and poor infiltration may occur in one part of a circle and moisture stress in another. Improving the structure of the topsoil can help alleviate some of these soil variation problems.

Difficult and unsuitable soils

Many growers who have installed centre pivots on very heavy Riverina soils (transitional red-brown earths and non-self-mulching clays) are experiencing serious infiltration and tracking problems due to these soils' low infiltration rates.

Sodic soils (exchangeable sodium percentage (ESP) > 6%) can be the cause of serious structure problems such as crusting and dispersion. Surface sealing, slow infiltration and drainage, and bogging are likely. There are other soils which will not wet after the initial irrigation and subsequent irrigation water runs off or ponds, causing further problems. Cracking soils can have very high initial infiltration rates and, when wet, can become extremely boggy.

If you decide to irrigate these difficult soils with centre pivots, consider using shorter machines and winter cropping programs rather than summer cropping.

Some soils which have suffered long-term structure degradation and have very poor infiltration rates may at first appear unsuitable. With appropriate management, the structure of many of these soils can be restored and the infiltration rate increased. NSW Department of Primary Industries (NSW DPI) has officers who specialise in irrigated soils advice.

Wheel tracks

Wheel ruts and bogging problems can be of concern when operating machines on heavier soils. Solutions to these problems include:

- correct tyre selection and pressures
- use of 'boom backs' and/or half-circle sprays behind towers
- building or 'development' and maintenance of tower tracks
- formed and sheeted tow tracks for end tow systems
- using fixed machines rather than towable systems.

With towable machines it is most important that the machine is correctly centred after each move to ensure wheels follow existing tracks. Great stress can be put on the machine structure if wheels are trying to climb in and out of existing ruts.

In multiple-circle systems using towable machines, tow tracks should be formed carefully (any more than minimal camber will cause the machine to slide sideways) to minimise problems when moving from circle to circle. Tow patterns should be planned to minimise end towing over wet soil.

Site preparation

The amount of time and money spent on site preparation will depend on natural topography, previous earthworks and the need for surface drainage. Natural drainage lines should be connected to allow surface water to drain if heavy rainfall occurs soon after irrigation.

Storages

A storage dam or large channel is very important for maximising the potential of the system. Storage is vital if water is supplied by a district channel system or is not available all year round. The storage must be sited on a suitable soil type and within a practical distance of the machine site. The size of storage will depend on the area being irrigated and an assessment of the cost in relation to the reduced risk of crop failure. It will be a significant component of the cost of the system.

Tree clearing

A major issue of concern for those considering adoption of these systems is the clearing of trees. Trade-offs such as planting areas and fencing areas for regeneration are options which may be negotiated. Without such trade-offs many conversions from surface to spray would not occur. Growers should approach the Department of Natural Resources before making proposals.

Water infiltration

Instantaneous infiltration rate (IIR)

The soil's infiltration characteristics are most important when choosing a machine. Soil must be able to absorb irrigation water without runoff. The maximum application rate is limited by soil infiltration rate. The soil's infiltration capacity is an important consideration as machine length increases.

Sprinklers at the outside end of the machine have to apply the water at a far higher rate than those at the inner end because they must cover a much larger distance and area in the same time to achieve the desired application rate in millimetres. See Table 1 and Figure 1 below.

The addition of an end gun to increase area of coverage is, in most cases, not a good idea because of the destructive effect of large, high-speed droplets hitting the soil and the high flow rate required. End guns operate at high pressures in the same way as travelling gun irrigators, and increase the cost per megalitre.

Table 1 shows examples of soil IIR required at the outer edge of different-sized circles fitted with 10 m diameter sprinklers. The bold figures (IIR) can also be interpreted as the equivalent rainfall rate of the outside sprinkler. There are few soils which can absorb water at the higher rates. Sprinkler patterns range from 5 to 20 m in diameter.

The bold figures at the bottom of the table give an equivalent in millimetres per hour application rate at the outside 10 m of the machine. Imagine the impact of receiving 131 mm* of rain in one hour on your soil! (Refer to Table 1.)

Structure of the soil can have a significant bearing on infiltration. A soil with good structure will have a higher IIR and will hold more plant-available water than a soil of the same texture with poor structure. In a direct drilled crop, infiltration will be accelerated where structure is good or where sowing tines have loosened or 'opened up' the soil. Air spaces left by decaying root material from the previous crop will contribute to improved soil structure. Where ridges are left behind sowing or cultivation equipment, infiltration opportunity time is extended by allowing water to be trapped in shallow furrows without running off.

Emitter (sprinkler) types are available which reduce droplet size, have an increased throw diameter and provide different actions to produce specific spray characteristics. Other options include fitting 'boombacks' and additional emitters to end spans. Sprinkler type and running pressure must be selected to suit soil type and machine size. Manufacturers of sprinkler/nozzle packages can provide such information.

There are sprinkler types which provide a large 'footprint' or wide diameter throw, and these can be run at pressures between 70 and 105 kPa (between 10 and 15 psi).

There are very few areas in the Riverina with undulations which require pressure regulators any higher than 70 kPa (10 psi). Unfortunately, many machines which have been purchased recently are fitted with 105 kPa (15 psi) regulators which cost 33% more to run than 70 kPa (10 psi) regulators.

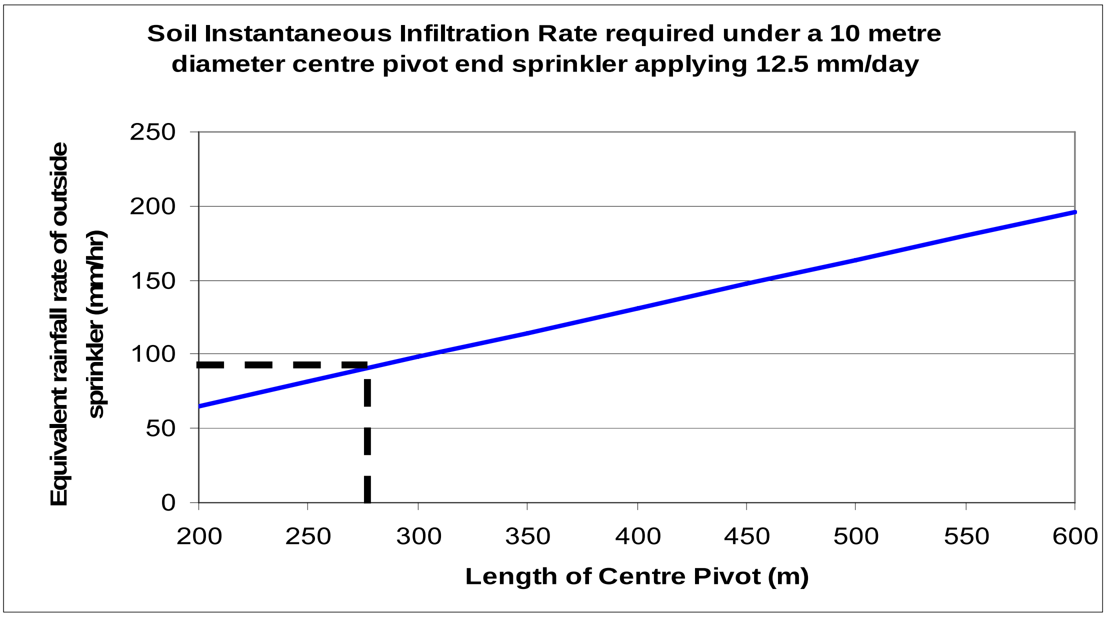
Figure 1 below shows the equivalent rainfall rate at the outside sprinkler or the rate at which the soil must absorb applied water without the water running off. The dotted line represents the example machine shown in the section Friction, pressures, capital and running costs.

Table 1. Instantaneous infiltration rate (IIR) of soil required at the outside sprinkler on various sized centre pivot irrigators at daily (24 h) application rate of 12.5 mm.

Length of pivot (radius, m)	200	300	400	500	600
Area — hectares	12.5	28.3	50.3	78.5	113.1
— acres	31	70	124	194	279
Distance around outside of pivot (m)	1257	1885	2513	3142	3770
m/h travelled (around circumference)	52	79	105	131	157
Opportunity time to cover 10 m (min)	11.5	7.6	5.7	4.6	3.8
Instantaneous infiltration rate required using a 10 m diameter sprinkler (mm/h)	**65**	**99**	**131***	**164**	**196**

Source: G Barron, L Evans, M Grabham, NSW Agriculture, 2002; B Slater, ServeAg, 2002.

* See associated text on page 3.



Source: Grabham and Barron, 2003.

Figure 1. Soil IIR required at the last sprinkler when applying 12.5 mm/day

Cropping options

Winter cropping

Winter crops can be spray irrigated when waterlogging risks associated with surface irrigation are unacceptable.

Multiple circles of winter crop can be grown with a towable machine, reducing capital cost per hectare to below that of surface systems in many cases.

To get the most from centre pivots on winter cropping, **an irrigation scheduling system must be used** which allows the grower to maintain adequate moisture levels at critical times (pre-flowering, grain filling). Scheduling irrigations means the crop can be irrigated at the right time to maintain readily available water (RAW) in the root zone. Yield is maximised if moisture stress is avoided, which means the system can be paid for as quickly as possible. Advice on scheduling can be obtained from NSW DPI.

Although monthly average rainfalls in spring in the Riverina appear adequate for good yields, actual rainfall is highly variable, **and in some weeks there will be no effective rainfall.** The unreliability of rainfall during this critical period and the capacity of the machine must be considered when deciding how much area is to be sown and the level of risk of moisture stress you are prepared to accept.

An advantage of spray irrigation is that it can be used outside the normal surface irrigation season with reduced risk of waterlogging the crop. In the major irrigation districts and areas relying on district supply systems, on-farm storage is needed to achieve this.

Summer cropping

Any crop or pasture **will use** the same amount of water to grow through the season and produce a given volume of product whether it is applied by surface *or* centre pivot. This water is to satisfy crop water requirements. It **does not include any losses from surface drainage or drainage beyond the root zone or other losses.** (Thompson, 2002, pers. comm.).

A soybean crop yielding 3 t/ha will need about 7 ML/ha, and lucerne yielding 16–18 t/ha will need about 10–12 ML/ha (even more for higher yields) in a year of near average rainfall in the Riverina. System losses are in addition to these volumes.

It is vital that the machine is able to meet the crop's water requirements through the whole of its growing period. A short period of stress at a critical time can mean the difference between making a profit or loss (this is particularly the case with maize). If you intend growing summer crop it is wise to size the machine to cope with extreme conditions. It is also vital to know if you can produce a profitable crop after allowing for *all* costs. For summer irrigation an overhead machine must be designed for lowest running costs.

When summer cropping in the Riverina, help from rainfall is unlikely, usually untimely and is of little significance in the water budget. **Budget for no assistance from rainfall**.

Foley and Raine's extensive report 'Centre pivots and lateral move irrigators in the Australian cotton industry' (2001) has a considerable amount of information on summer cropping (cotton) under overhead irrigation machines.

Much of Australian cotton is grown in summer rainfall areas which reduces the amount of irrigation required. Summer crops grown in the winter/spring rainfall zone in the south of the state will usually require more water to be applied through the irrigator.

Summer cropping will require dedication of the machine to one circle for the duration of the crop.

Lucerne and perennial pastures

Many Riverina growers invest in centre pivots with the view to include lucerne in their enterprise.

Highly productive lucerne requires the right soil, good agronomy and between 10 and 12 ML/ha depending on the season and whether the crop is to be used for intensive haymaking or combined with grazing or seed production.

A Barooga grower has produced up to 20 t/ha lucerne dry matter (DM) under a centre pivot which applies 12.5 mm/day and operates **6.5 days a week throughout the growing season** (except during harvest periods (4–10 days). This is necessary to maintain adequate moisture throughout the active root zone and to ensure a moisture reserve during harvest. In the first week after mowing, lucerne's crop growth factor is much less than its average.

Losses of 1–2 mm per day should be allowed for, comprising evaporation from leaf surfaces and from the soil surface (especially on windy days). The losses from the part of the crop watered during the daytime will be greater than those from the area irrigated at night.

CSIRO work has shown that for the majority of the growing season, lucerne's crop factor is between 1 and 1.3. This means that in hot Riverina summer weather (10 mm daily evapotranspiration) it will use between 10 mm and 13 mm of water per day. **The machine must be able to deliver at least 13 mm per day just**

to keep up and the grower must accept a yield penalty during extreme conditions when evapotranspiration from the crop (ET_{crop}) exceeds the machine's maximum delivery rate.

In a summer like 2002–03 when evapotranspiration was far higher than normal and there was little effective rainfall, a crop which gets behind with its water supply may not be able to catch up.

Perennial pastures

Highly productive perennial pastures can be expected to use about 80% of the amount of water used by lucerne per day but their growing season is longer. Problems can occur if water supply becomes limiting during hot spells, as traditional summer pastures containing white clover cannot withstand even low levels of water stress.

Friction, pressures, capital and running costs

As soon as we start pumping water through pipes we come up against **friction**. Friction becomes a significant factor when the **velocity** of the water in the pipeline rises above about 1.5 m/s.

Friction is the main contributor to the running costs of a centre pivot irrigator.

This friction load is measured as a pressure – kilopascals (kPa), pounds per square inch (psi) or the equivalent in metres head (m). Formulae for calculations use metres head (m).

Foley and Raine (2001) recommend that to keep running costs at an acceptable level **for summer crop (cotton),** a machine using sprinklers with an operating pressure of 7 m head (68.6 kPa or 10 psi) should have a centre pressure no greater than 15 m head (215.6 kPa or 22 psi).

There are very few machines being sold in the Murray valley which meet this suggested requirement. Most of them require a pressure between 20 m (196 kPa or 29 psi) and 40 m (392 kPa or 58 psi) at the centre of the pivot.

As the length (and irrigated area) of a machine increases, the capital cost per hectare is reduced; but the cost of operation due to friction in the mainline and in the machine can make the system less economical. Machines over about 440 m in length are usually too large to move safely and so are fixed in position. This increases capital cost per hectare as it can irrigate only one circle.

The higher capital cost of using larger pipe sizes in both the machine and the supply line to reduce running costs must be considered when designing and pricing the system.

How much extra capital should be spent to reduce running costs?

Before you do the calculations you will need to decide whether or not you want to grow a summer crop—the more water you use, the more significant a small change in running costs will be.

The cost of overcoming friction is a major component of the calculations which must be performed to minimise running costs over the life of the machine. It may well be cheaper over the life of the machine to pay more capital up front for a system with lower friction load than to pay the extra running cost of a cheaper system for years to come. The more water that is pumped, the more critical this decision becomes.

It is impossible to say whether one system will be cheaper to run than another without doing the calculations specific to the site/situation.

The **following examples** show the effect on running costs of varying capital costs.

This calculation is based on a 282 m long (25 ha) machine delivering 12.5 mm/day on three circles, growing **two circles of winter crop and one circle of summer crop.**

The only differences are the diameters and prices of the main supply pipeline. Costings assume water is being pumped for the whole 1500 m of pipeline (from water source to the centre of the machine). The average cost will vary depending on which circle is being used for which crop, that is, lower cost at closest circle. **Using different pipe sizes in the actual machine, emitter pressure and setting of pressure regulators have not been considered in these calculations.**

Table 2. Flow rates, velocities, friction, pressures and power requirements for the example

Mainline pipe size (mm)	Flow rate (ML/day)	Velocity (m/s)	Friction load for 1500 m of pipe	Metres head required at centre	Total head required	kW required to pump it
150 mm	3 ML/d	2 m/s	33.9 m	20 m	53.9 m	30.56 kW
200 mm	3 ML/d	1 m/s	5.0 m	20 m	25 m	14.18 kW

In this example it is assumed that winter crop will use 2 ML/ha/year and summer crop 9 ML/ha/year.

Summer crop: 25 ha x 9 ML/ha = 225 ML

Winter crop: 50 ha x 2 ML/ha = 100 ML

= **325 ML**

The following costs per megalitre are calculated using pipe friction calculations provided by a pipe manufacturer, using the standard formulae shown in the next section Calculating power and water requirements, and a diesel power source.

Cost per ML on paddock through a **150 mm** pipeline = $41.60/ML

× 325 ML = **$13,520 pa**

Cost per ML on paddock through a **200 mm** pipeline = $19.28/ML

× 325 ML = **$6,266.50 pa**

Difference **$7,253.50 pa**

($22.30/ML fuel saved using larger pipe)

The current (2005) capital cost of pipeline in Class 6 × 150 mm PVC pipe is approx. $9.20/m and Class 6 × 200 mm is approx. $19.60/m, a difference of $10.40/m.

A 1500 m pipeline in 200 mm costs $29,400 compared with 150 mm costing $13,800.

Difference **$15,600 (extra cost of larger pipe)**

The difference in capital costs is recouped in a little over two seasons or when 700 ML has been pumped. A saving of $22.32 per megalitre continues for the life of the machine.

Another simple example is based on a 50 ha towable machine, and growing **winter crops only**, on three circles using 2 ML/ha/year for 20 years:

50 ha × 3 circles × 2 ML/ha/year × 20 years = 6000 ML/20 years

Pumping cost of $50/ML—it will cost $300,000 to run for 20 years.

Pumping cost of $40/ML—it will cost $240,000 to run for 20 years.

Question: Will it cost $60,000 in extra initial capital cost to size pipes to reduce running cost from $50/ML to $40/ML?

Answer: No. More likely less than an extra $10,000.

As the cost of energy (diesel *or* electricity) rises in the future, savings on energy become more and more attractive. You will soon forget a small increase in initial capital cost but you will always think of the running costs when the diesel truck drives in to fill the tank.

An experienced operator who grows both winter and summer crops has said:

> **'Design the system for minimum running costs, *then* price it.'**

Further reductions in friction load can be made by increasing the pipe size of the inner spans of the machine. Standard diameters of span pipes are 6⅝″, 8″ and 10″ (168 mm, 204 mm and 255 mm). It is quite common for the first three spans (3 × 53 m) or 160 m of a 400 m long machine to be built from 8″ pipe and the rest from 6⅝″. This gives a significant reduction in friction in the actual machine.

You should request estimates of running costs when negotiating the purchase of a system, and changes to these costs attributable to different pipe sizes and application rates.

Pressure regulators

Pressure regulators are fitted on the drop tubes above the sprinklers. They are used to ensure that all sprinklers are supplied with water at the same pressure in order to achieve even application. Pressure regulators also ensure that sprinklers operating at lower or higher levels than others (in undulating or hilly terrain) do not deliver more or less water than required.

Sprinklers are designed to operate at a pressure which will produce the desired droplet size, distribution and throw distance. On soils with low infiltration rates a larger spray diameter is desirable as the wetting 'footprint' needs to be larger than that needed for lighter soils.

Wherever possible, lower pressures should be used to reduce running costs. Machines in the Murray valley have either 10 or 15 psi pressure regulators. If you are able to run the machine at the lower pressure, you should do so.

The pressure above the pressure regulator on the last sprinkler (outer end of machine) should be just higher than that of the pressure regulator to ensure the regulator's correct operation.

Sprinkler package manufacturers can provide information on pressures required for different sprinklers, droplet characteristics, spray patterns and diameters.

Calculating power and water requirements

(Sourced from NSW DPI irrigated cropping handbooks for Southern irrigation areas (Murray and Murrumbidgee.)

To perform these calculations you need the head required (in metres) at the discharge of the pump, the area covered by the machine and the application rate required. These figures should be available from the suppliers of the machines—if in doubt, check with an independent engineer.

Some simple, example calculations based on a 24 ha machine delivering 12.5 mm in 24 hours:

The water supply rate required:

Circle area (ha) × mm applied/day x 0.01 = ML/day

e.g. 24 ha × 12.5 mm/day × 0.01 = 3.00 ML/day

Power required:

$$\frac{\textbf{Flow rate (litres/sec) × total head (metres)}}{\textbf{102 × pump efficiency* × motor derating}^{\dagger}} = \textbf{kW required}$$

$$\text{e.g.} \quad \frac{\text{34.7 L/s (3.75 ML/day)} \times \text{28 m}}{102 \times 0.8 \times 0.75} = \text{15.9 kW}$$

* A new pump is expected to be 80% efficient. This figure drops as the pump wears—old pumps should be checked and if necessary refurbished. An inefficient pump costs more to run and may not pump the required amount of water.

† Derating is an allowance made for inherent inefficiencies in power sources: 0.75 for diesel engines and 0.8 for electric motors.

It is also most important to realise that a pump selection for a particular machine is an exact process - do not assume that your old pump will necessarily do the job, even with adjustments. The pump must be matched to its proposed duty.

Diesel fuel cost:

kW × 0.34 L/h/kW = L/h × $1.00/L = $/h

e.g. 15.9 kW × 0.34 L/h/kW

= 5.4 L/h @ $1.00/L

= $5.40/h

$$\frac{\$5.40 \times 24\text{ h}}{3.00\text{ ML}} = \$43.20/\text{ML}$$

The figures above for diesel-powered systems do not take into account the costs of oil, filters and down time involved in servicing.

Electricity cost

Electricity tariffs vary with the supply authority and type of metering used. It can become quite complex and there can be considerable variation depending upon the hours of the days and the days of the week the irrigator is operated. You should consult your local supply authority to discuss supply and charging options.

One authority's charge averages 10.14 cents/kWh (or unit).

10.14c/kWh × kW = $/hour

e.g. 10.14c/kWh × 15.9 kW = $1.61/hour

$$\frac{\$1.61 \times 24\text{ h}}{3.00\text{ ML}} = \$12.88/\text{ML}$$

In addition to the unit (kWh) cost to run the machine there are standing fees—the supplier quoted above charges $2.32 per day for service supply or $847 per annum (at the time of writing), which can be divided by the number of megalitres pumped in a season to give $/ML.

Advantages of electrical systems include their extremely low maintenance requirements and ease of automation.

Driving the irrigator

Another cost is that of driving the irrigator. This task may be performed either by a diesel-powered generator or mains if available, or a hydraulic pump at the pivot point (depending on type of drive system). Suppliers' representatives should be able to tell you the cost per hour of driving the machine.

Design options

Companies which manufacture centre pivot irrigators usually provide a design service included in the price of the machine. They have computer programs which can calculate flow rates, pressures, travel speeds and application rates.

From these programs they are able to select the appropriate pump and match the power source to demand. Pumps and motors/engines are usually sourced by the irrigator's manufacturer to suit their machine and are included in the package.

Pumps have limited working ranges as do motors and engines. It is most important that instructions to the supplier with regard to the proposed cropping program, maximum crop water requirements and the required level of versatility of the system are clear.

A decision to use a diesel or electrically powered machine will depend largely on proximity to electricity. Automation, fail-safe mechanisms and maintenance of an electric machine is far cheaper than that for a diesel machine, but, if supply lines are not close, electricity connection costs may be prohibitive. Diesel/electric machines have the advantages of electric drive motors and control systems. Towable diesel/hydraulic machines incorporate a tower jacking system which allows rapid movement between circles on multiple-circle systems.

Drive and transport systems produced by the different manufacturers should be assessed for individual needs and in the light of other operators' experiences.

Let's look at the initial calculations needed before choosing a machine

It is considerably cheaper to calculate capital and running costs of several different options **before** you sign the cheque, than to discover you've made a mistake when the machine is installed in the paddock.

To avoid a potential financial disappointment you should do as much on paper as you can.

Speaking to a range of operators with experience should be a high priority in your investigations, but remember, people enjoy telling their success stories much more than their tales of woe.

Information necessary to help you calculate the economic viability of installing a machine includes the following:

- Size and number of circles.
- Is it to grow winter crops, pasture, lucerne or annual summer crops, or a combination?
- How many megalitres are to be applied through the machine **during its life** (determined by proposed cropping regime)? (This question is difficult to answer because who can say what you will be growing, or what you will want to grow, in 10 years time.)
- How much is it going to **cost per megalitre** to get the water from the source on to the paddock? (Calculate the average cost per megalitre, as it will cost more on the furthest circle.)
- How much profit from which crops or pastures can you predict (conservatively)?

It may be necessary to make calculations on the basis that you intend growing a summer crop in order to have that potential, even though it may not be something you want to do straight away (or may never do). A towable machine system sized to allow economic irrigation of one circle of summer crop will be able to irrigate multiple circles of winter crop easily, but if you select a machine with just adequate capacity to grow winter crops you may well find it is not up to the much bigger job of producing a high yielding summer crop.

Help in selecting a machine

Suppliers' representatives should be able to provide the answers to your questions through specification sheets.

If you are not confident in your ability to interpret technical information or the supplier is unable to tell you the running cost of the machine, an opinion from an independent engineer or irrigation adviser will be of good value. NSW DPI Irrigation Officers can also assist you with interpretation of technical information.

Ongoing availability of service, spare parts and support from the manufacturer and supply agency should be investigated.

You need to have a good knowledge of your soils’ characteristics and their potential for structural improvement to determine IIR, and it may be worthwhile speaking to a soils specialist.

Discussing your thoughts with experienced operators/growers will increase your chances of making the correct decisions. They will be able to give you many ‘dos and don'ts’ regarding operational matters.

NSW DPI Irrigation Officers and District Agronomists are an impartial source of information.

For more information contact:

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Robert Hoogers (Irrigation Officer, Yanco), ph. 02 6951 2628.

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