DPI&F note

Purchasing a centre pivot or lateral move

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Step 1 – Planning

Calculate the required system capacity

System capacity (mm/day) is a measure of the ability of these systems to meet the crop water requirements for an extreme three day evapotranspiration event. It is found by dividing the January Point Potential evapotranspiration value for your location (see the Bureau of Meteorology maps at www.bom.gov.au) by the cotton industry calibration factor (21.5). This calibration factor has been determined after thorough investigation of existing cotton centre pivot and lateral move installations and their ability to meet cotton crop water requirements.

Determine water availability

Make sure you have sufficient water to grow your crop (typically centre pivot and lateral move irrigated crops require 30-40% less water than surface irrigated crops).

A variable supply rate results in variation in machine performance. For lateral moves consider the flow rates into supply channels and available head along the channel length. Groundwater supplies are often limited by the possible extraction rate – check this rate at the end of the season with a 48 hour bore pump test.

The supplied water flow rate is the lesser of the supply infrastructure capacity (channel and storage or aquifer extraction rate) or the maximum pump flow rate permissible by the machine manufacturer (around 300 L/s for large lateral moves).

Estimate your irrigated area

The possible irrigated area is estimated using the formula:

$$\text{Irrigated area (ha)} = \frac{\text{Pump flow rate (L/s)} \times 60\text{s/min} \times 60\text{min/hour} \times 24 \text{ hours/day}}{\text{System capacity (mm/day)} \times 10{,}000}$$

In the case of lateral move systems the irrigated area is that which is irrigated in any one season. The machine may actually have a larger area it can cover, but some of this may be fallow.

Physical considerations

Water quality should be analysed for its potential corrosiveness. Stainless steel or poly-lined systems are available for poor water quality situations.

Physical and biological contaminants may be an issue (especially where supply is by open channels). Consider filtration to minimise nozzle blockages.

Try not to have soil type variation under a machine. If this is unavoidable, avoid variation across the length of the machine; have the machine travel over changes in soil type so that application strategies can be modified.

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Full land levelling is not typically required, although fields should be cut to drain. Issues can occur under machines with LEPA systems when water runs and collects in lower areas – localised water holding strategies like dyking become important.

Step 2 – Design

Centre Pivot or Lateral Move?

Centre pivots have half the labour requirements of lateral moves and are easier to manage as dry ground is always directly in front of the machine. Lateral move channels allow evaporation and seepage losses, and require maintenance. Trash accumulation in channels accounts for the majority of machine shutdowns - trash screens are essential but do not stop this problem as trash is deposited back in the channel.

On larger centre pivots the average application rate on outer spans can be very high resulting in poor infiltration and surface runoff. Avoid end guns and racetrack machines.

Span pipe sizes & operating costs

Machines are often specified with all small diameter (6&5/8”) pipe which has higher friction losses than larger pipe sizes at the same flow rate. Using larger pipe sizes (8” or 8&5/8”) on larger machines will significantly decrease operating costs due to lower pressure requirements.

Ensure span lengths reflect your farming practice - if you want exactly 48.0 metre spans you will need to specify this to the supplier.

Sprinkler package

Sprinklers, nozzles and pressure regulators represent about 7% of capital cost but are responsible for 70% of irrigation performance. Try to use a package with as low pressure as possible to reduce operating costs - 6psi, 10psi and 15psi packages are common but 6 or 10 psi is usually adequate.

Sprinklers are necessary for germination, typically with a reduced nozzle size to limit flow rate. Sprinklers or LEPA may be used throughout the rest of the crop life. Be aware that you need to keep water where it is placed with either system, but more importantly with LEPA (dyking and stubble retention are possible solutions).

Step 3 – System performance

System checks

Have a system check performed by the supplier to ensure that the delivered machine is performing as it should (at least system capacity, distribution uniformity and energy consumption). Unfortunately there are typically few commercial providers of irrigation system auditing services.

System capacity

System capacity is the maximum rate at which water (mm/day) can be applied to the irrigated area. A low system capacity means peak crop water demand cannot be met. To check system capacity measure the daily pump flow rate (ML/day) and the irrigated area (ha) and insert these values into the formula

$$\text{System Capacity (mm/day)} = \frac{\text{Flow rate (L/day)}}{\text{Irrigated area (square metres)}}$$

Uniformity

Uniformity refers to how evenly water is applied across the field. The benchmark value for centre pivot and lateral move uniformity is 90% - below this yield variation and poor water use efficiency results.

Uniformity is measured by a catch can evaluation; this allows a comparison of the depth of water applied at various points within the field.

Average application rate (AAR) (mm/hr)

Average Application Rate is the ratio of an individual nozzle flow rate to its wetted area. Where the AAR exceeds the soil infiltration rate runoff results. This is usual at the end of long centre pivots and for all LEPA systems. This runoff can be managed by using dyking, surface roughness and stubble retention.

Increasing the number of sprinklers or decreasing the flow rate per sprinkler can decrease the AAR.

Field application efficiency

Field application efficiency is a measure of the amount of water available to the crop compared to that supplied to the field. Potential water losses result from runoff, deep drainage and evaporation (usually less than 5% for modern low pressure sprinkler systems). The benchmark application efficiency for LEPA is 98%, and for sprinklers, 95%. The formula for field application efficiency is:

$$\text{Application Efficiency} = \frac{\text{Irrigation water available to the crop}}{\text{Volume of water supplied to field}} \times 100$$

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