Centre Pivots and Lateral Move Irrigation

Applicability: Wide variety of crops & soil types

Capital Cost:
- Centre Pivot = $2,500 to $5,500 / ha
- Lateral Move = $2,500 to $5,000 / ha

Annual Costs: Ongoing maintenance, energy and pumping costs

Strengths:
- Precise application of water
- Reduced labour requirements
- Flexibility in farming system options

Weaknesses:
- Energy and pumping costs
- Higher levels of skills required to operate and realize water savings
- Capital costs

Centre pivots and lateral moves (CPLM) offer greater control and flexibility of irrigation management. Increasing pressure on water availability, potential yield improvements, more control of soil water within the root zone of the crop, reduced labour and potential for fertigation and chemigation are some of the factors which have created an interest in this technology (Foley & Raine, 2001).

Applicability

Typical applications: CPLM machines are generally not limited by crop, soil type of regional characteristics. Systems will work effectively on a wide range of soil types and across a full range of climatic conditions. Machine size is a function of a number of factors including the availability of water resources; soil texture and structure; peak irrigation demands (crop); site topography; energy costs and machine limitations of different manufacturers. CPLM are generally effective if designed and managed appropriately. CPLM are usually no longer than 500m (commonly 400m) which equates to a maximum size of 70ha. Labour is half the requirements for a lateral move and about 1/10 the labour requirement of surface irrigation. Centre pivots are generally easier to manage as dry ground is always directly in front of the machine (with the exception or part circle machines which can go both directions). On larger machines the average application rate (AAR) on outer spans can be very high causing problems with poor infiltration and surface run off. The longer the centre pivot system, the greater the challenge to control the AAR under outer spans to avoid surface run off, particularly where the infiltration rate of the soil is low (Foley & Raine, 2001).

Lateral moves are particularly popular in Australia and especially in the cotton industry. They are better suited to the rectangular shape of surface irrigated fields than the circular wetting area of the centre pivot. In Australia, machines of up to 1200 m in length have been installed. LM machines are not as commonly used overseas,
and, when used in other crops, are rarely greater than 500m long. Within Australia, LM’s are commonly 800-1000m long and indicatively cover an area of 165 ha. Compared to CP’s, LM’s require level, rectangular blocks, require more management as the driest ground is not always immediately in front of the areas requiring water most is at the opposite end of the field. Additional labour is also required to supervise the machine (ie guidance systems) and maintain supporting infrastructure such as channel supply systems.

Applications within Healthy Headwaters:
CP and LM represent approximately 15% of the irrigated study area (grower survey), the second most significant irrigation system next to surface irrigation in the QMDB. CP’s and LM’s are most likely to be the most populate option where growers within the QMDB are considering an infield irrigation system change. The major drivers for adoption of CPLM include potential water savings, labour savings and yield improvements. Other key advantages identified by Foley & Raine (2001) over traditional surface irrigation systems include the ability to more precisely manage irrigations for eg apply smaller volumes on preseason irrigations, improved crop germination, more uniform applications, better use of in season rain events, reduced potential of water logging and the ability to use deficit irrigation strategies.

Water Savings
Documented range of water savings:
While efficiencies are strongly influenced by management practices, well managed centre pivots/lateral moves commonly produce application efficiencies in excess of 90%. Low pressure, static plate sprinklers on centre pivots/lateral moves typically operate at 80–90% application efficiency while moving plate sprinklers have application efficiencies up to 95%. Low energy precision application (LEPA) socks and bubbler emitters have been found to have application efficiencies up to 98% where surface run-off is controlled with furrow dikes. In many cases these systems are managed to apply the same amount of water that would have been used in a surface system in order to attain higher yields based on the irrigation efficiency gains.

Factors affecting the range of water savings:
Generally the performance of Centre Pivots and Lateral moves is less sensitive to factors directly affecting volumetric water savings and more sensitive to equivalent water savings through improved productivity. In terms of volumetric water savings, variation in water loss components such as deep drainage, evaporation losses and runoff are limited in practice by the capacity of these systems. Modern sprinkler options also limit the variation in losses by reducing wind drift, evaporative losses and runoff. The greatest potential for water losses and variation in volumetric water savings will most likely occurs as a result of surface runoff. This is particularly significant for Centre Pivots where the average application rate exceeds soils infiltration characteristics on the outer spans. This can be improved by increasing the wetted footprint through different sprinkler options or configuring multiple sprinklers (i.e. same flow rate) on spreader bars.

Ability to measure/quantify the water saving:
Measures of machine performance include Application Rate (System Capacity, Managed System Capacity, Average Application Rate, Instantaneous Application Rate), Uniformity of Application and Application Efficiency.

Costs
Capital costs: Typical capital costs associated with Centre Pivot / Lateral Move irrigation systems range from $2,500 to $5,500 / ha and $2,500 to $5,000 / ha respectively. The capital costs associated with the purchase of a Centre Pivot / Lateral move include the purchase of the machine and installation costs including earthworks. In addition to the cost of the machine other items include pipe work, pumping equipment and the power plant (either diesel or electric) which are included in the costs above. Other capital costs more site specific could include power lines (and connection), supply channels, laser levelling, land clearing and road construction. Laser levelling / land forming are often limited to cut to drain as opposed to cut to grade. These additional items can add up to 50% of the system cost.
The unit cost (i.e. $ / ha) of both Centre Pivots and Lateral Moves is generally less for machines servicing a larger area. The most significant influence on machine price is the pipe diameter of spans. Smaller pipe size, while reducing the purchase price of the machine will increase the ongoing operating costs which can be as significant over the lifetime of the machine as the original purchase.

**Operational costs:** As a general rule of thumb the operating pressure at the centre of the machine or supply point shouldn’t exceed 205 kPa (30 psi). Operating at pressures higher than this can result in significantly higher pumping costs. Conversely operating at pressures too low may be a bigger problem, by compromising the performance of the sprinkler package therefore leading to irrigation non-uniformity and poor crop performance. Other operating costs include labour. Anecdotal evidence (Foley and Raine, 2001) suggests labour requirements of lateral moves are 10 times less than surface irrigation while 50 to 80% more than a Centre Pivot.

**Skill and Management Requirements**

**Installation considerations:** There are a number of factors to take into account prior to installation. These include consideration of financial, planning, design, operational and maintenance aspects. New users are referred to the Centre Pivot and Lateral Move training developed by the CRC for Irrigation Futures (www.irrigationfutures.org.au) to fully consider the range of issues and implications.

Balancing the initial capital investment with the on-going operating costs is an important consideration at the design stage. These comparisons can be made by comparing the present value of ongoing costs with the purchase price to determine the best option.

System capacity is also a fundamental consideration in ensuring the machine is capable of meeting the crop demands. There are many examples where machines have suffered from inadequate system capacity and were not able to keep up with crop demands and user expectations.

On commissioning it is important to assess the performance of the system to ensure that the system is operating to specification. System checks include uniformity, flow rates, pressures and machine calibration. General advice is to include terms in the sales contract to withhold final payment until the performance of the machine is independently assessed and verified to meet the design specifications.

**Operational considerations:** While labour requirements for these systems can be as little as 10 per cent of surface irrigation systems, the level of skill required is much higher. Centre Pivot and Lateral Move systems apply relatively small amounts more frequently to keep up with crop water demands. Irrigation scheduling becomes vitally important given there is a small margin for error. Added complexity results from different parts of the field being at different soil moisture deficits. This may also be amplified due to soil variations. To assist new users with some of these complexities the visualization tool OVERSched (www.irrigationfutures.org.au/OVERsched/OverSchedv1-0.html) has been developed to illustrate how management decisions influence crop water stress.

It is generally accepted that the transition to Centre Pivots / Lateral Moves can take up to three years before new users are “up to speed”. During this transition phase access to expert support is an important consideration if these systems are to achieve their full potential sooner. While access to generalised advice on the
management of these systems is important to smooth the transition other specialist irrigation consultants undertake comprehensive checks using dedicated equipment and techniques to determine the system performance in detail and recommend where improvements can be made.

Impediments to Adoption
The main impediment to adoption of Centre Pivots and Lateral Moves is the increased operating costs associated with pumping when compared to existing surface irrigation systems. Higher skill requirements may also cause some impediments, particularly where there is limited access to labour. This is particularly important given the higher skill set is required to not only operate the system but to realise water savings. A broader barrier is a perception that Centre Pivots and Lateral Moves do not have sufficient capacity to meet crop demands particularly where surface irrigation systems are currently used.

Environmental Impact
Limited (none)

Further Information
For a full copy of An appraisal to Identify and Detail Technology for Improving Water Use Efficiency in Irrigation in the Queensland Murray Darling Basin go to:

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Photographs used have been accessed from the following sources:

Contact Us
Graham Harris – Toowoomba
(07) 4688 1559

Nikki Pilcher – St George
(07) 4620 8109

Bec Raymond – Goondiwindi
(07) 4671 6711

Jenelle Hare – Dalby
(07) 4669 0825

Lance Pendergast – Emerald
(07) 4983 7416

Mary Philp – Toowoomba
(07) 4688 1211

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