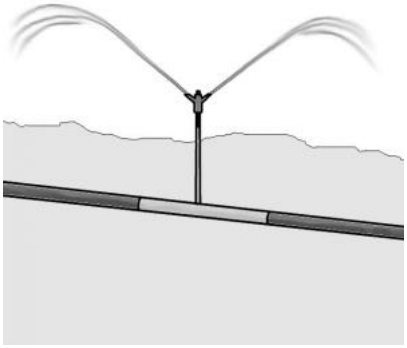
Sprinkler Irrigation



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Sprinkler irrigation is a method of providing rainfall-like irrigation to the crops. Water is distributed through a system of pipes usually by pumping. Spray heads at the outlets distribute the water over the entire soil surface. Sprinklers provide efficient coverage for small to large areas and are suitable for all types of crops. Furthermore, they can be adapted to nearly all irrigable soils since sprinklers are available with a variety of discharge capacities (FAO 1988). However, sprinkler systems can easily clog with the presence of sediment or debris and large systems incur high capital costs.

In	Out
Freshwater, Treated Water	Food Products

Basic Design Principles

Sprinkler Heads

Impact and gear-drive sprinklers are two general types of sprinklers used in lawns, gardens and pastures. They produce moving streams of water and spray nozzles that discharge water on the whole wetted pattern at all times. Impact or gear-drive sprinklers can accommodate only full or part circle application patterns. Since each sprinkler covers a large area (typically 12 m head-to-head spacing), they are used on pastures and larger lawn areas.

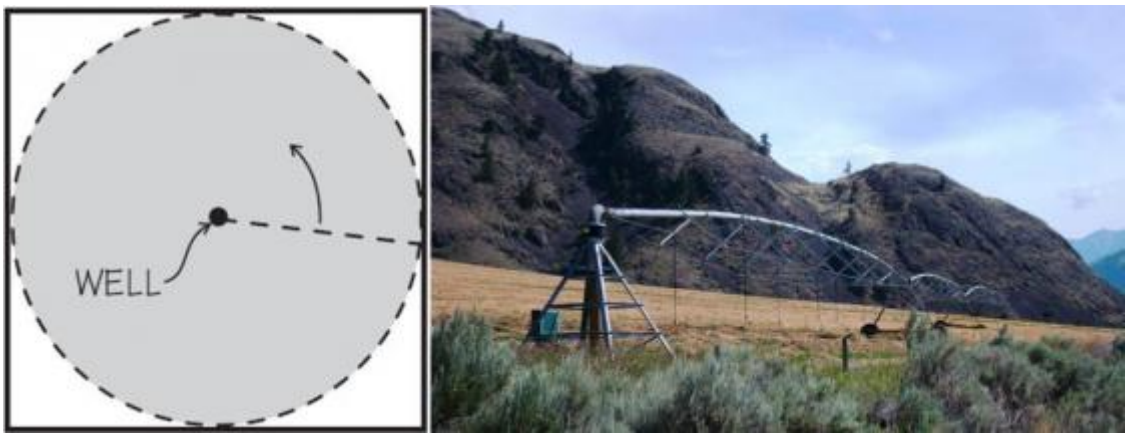
Left: Portable impact sprinkler head connected to a garden hose. Right: Pop-up half circle spray heads fed by a subsurface hose. Source: NEIBLING and ROBBINS (n.y.)

Several sprinkler heads are connected to a lateral pipe, which is supplied by a mainline. Source: TRADEINDIA (n.y.)

These sprinklers may be used in a solid set configuration where sufficient nozzles are installed to cover all parts of the desired area drawing water from a surface or buried mainline and laterals. Or they can be used in a set-move configuration where lateral lines are operated and then moved at intervals of 12 or 24 hours. Solid set systems cost more to install, but have lower labour requirements and may be automated. The equipment and installation cost per acre of set-move systems is less expensive, but their operation requires more labour, as they cannot be completely automated.

Centre Pivot

This self-propelled sprinkler system rotates around the pivot point and has the lowest labour requirements of the systems considered here. It is constructed using pipes attached to moveable towers. The amount of water applied is controlled by the speed of rotation. Centre pivots can be adjusted to any crop height and are particularly suited for lighter soils. With a computerised control system, the operator is able to program many features for the irrigation process. Furthermore, it is possible to install a corner attachment system (also called “end-gun”) that allows irrigation of corner areas missed out by conventional centre pivot systems.



Left: A centre pivot system irrigates up to 132 acres (~0.5 km^2). Source: SCHERER (2010). Right: Centre pivot irrigation in the south of British Columbia, Canada. Source: B. STAUFFER (2011)

Linear Move

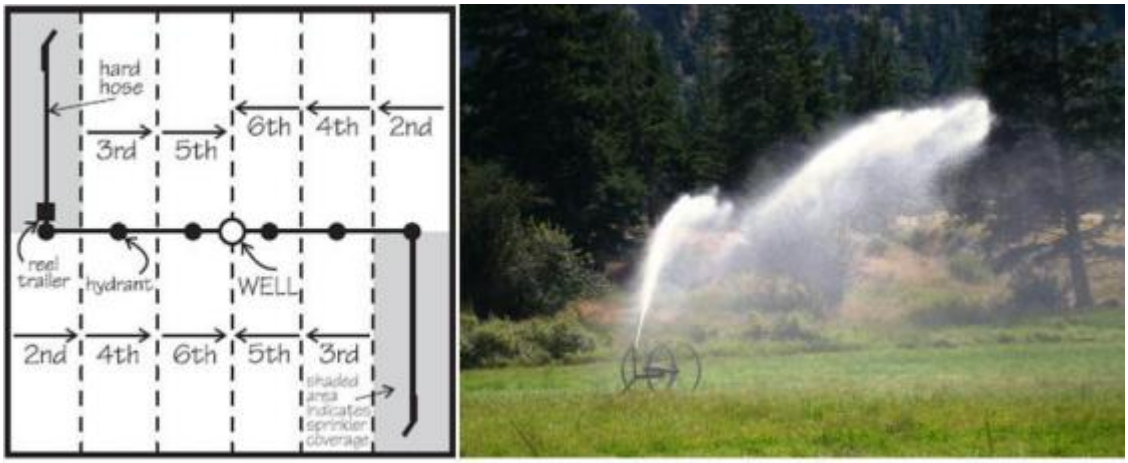
The linear move (also called lateral move) irrigation system is built the same way as a centre pivot; that is moving towers and pipes interconnecting the towers. The main difference is that all the towers move at the same speed and in the same direction. Water is pumped into one of the ends or into the centre. Due to the high capital investment, linear moves are used on high-value crops such as potatoes, vegetables and turf.

A linear move system irrigates rectangular fields of one by half a mile. It is a common system for very large fields, e.g. in the prairies of Alberta, Canada. Source: SCHERER (2010) and B. STAUFFER (2011)

Travelling Big Gun

The travelling big gun system uses a large-capacity nozzle and high pressure to throw water out over the crop as it is pulled through an alley in the field. Travelling big guns come in two main configurations: hard-hose or flexible-hose feed. With the hard-hose system, a hard polyethylene hose is wrapped on a reel mounted on a trailer. The trailer is anchored at the end or centre of the field. The gun is connected to the end of the hose and is pulled towards the trailer. The gun is pulled across the field by the hose winding up on the reel. With the flexible-hose system, the gun is

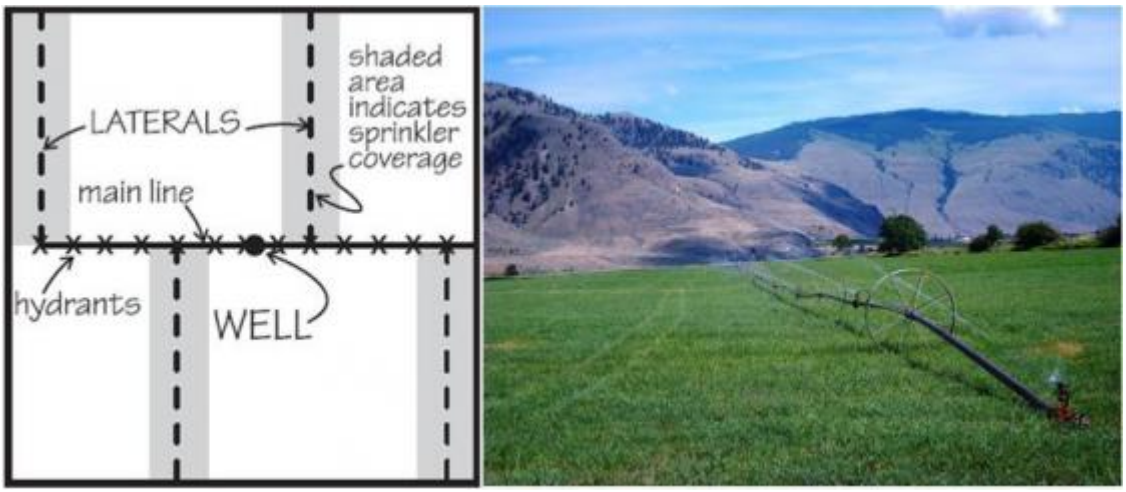
mounted on a four-wheel cart. Water is supplied to the gun by a flexible hose from the main line. A cable winch pulls the cart through the field towards the cart.



Most big gun systems are used on a maximum of 80 to 100 acres per gun (~0.3 to 0.4 km^2). Source: SCHERER (2010) and B. STAUFFER (2011)

Side Roll

The side roll (also called wheel roll) system consists of a lateral, usually a quarter mile long, mounted on 4 to 10 foot (1 to 3 meters) wheels in diameter and the pipe serving as an axle. When the desired amount of water has been applied to an area, a gasoline engine at the centre is used to move the side roll to the next. The sprinklers are generally mounted on weighted, swivelling connectors so that no matter where the side roll is stopped, the sprinklers will always be on top. This type of system is not recommended for gradients greater than 5 per cent and should be used mainly on flat ground. Side roll systems are adapted only to low growing crops, have medium labour requirements and moderate initial investment.



Wheel line irrigation system in the south of British Columbia, Canada. Source: SCHERER (2010) and STAUFFER (2011)

Cost Considerations

The costs of the different systems vary. Except for small sprinkler equipment for gardening, big systems such as linear move or centre pivot irrigation incur high capital costs. It is important to also consider operation and maintenance costs for these technical and sometimes computer controlled systems.

Operation and Maintenance

Depending on the system, expert knowledge is necessary to carry out irrigation. It is important to maintain the whole facility. Motors, water supply pipes/hoses and all mechanical components have to be kept in shape to avoid damage and high repair costs. The operation and maintenance of irrigation equipment for gardens, such as sprinkle or spray heads, is not tricky and thus easy to handle for everyone.

Health Aspects

When water quality is very low (e.g. wastewater) and/or solvable fertiliser was added, workers should not stand close to the irrigated field to avoid contact with the water (see also waterborne diseases pathogens and contaminants).

Applicability

Sprinklers are suited best for sandy soil with high infiltration rates although they are adaptable to most soil types. The average application rate of the sprinklers (in mm/hour) is set lower than the basic infiltration rate of the soil so that surface ponding and runoff can be avoided. Sprinklers are not suitable for soils that easily form a crust or in case of risk of salinisation. Moreover, they can easily clog with the presence of sediments or debris. If sprinkler irrigation is the only method available, then light fine sprays should be used. Sprinklers producing larger water droplets should be avoided (FAO 1988).

Advantages

- No terracing required
- Suitable for almost all types of soil
- Doses, application rates and times adaptable to the needs of the plant and soil type
- Independent from the topography of the area (even areas located at higher elevations than the source can be irrigated)
- Utilisation of the entire area with no need for channels (HOVE 2011)
- Possibility of adding fertilisers or pesticides
- Possibility of irrigating for other purposes: sprouting, frost protection or cooling during hot periods (HOVE 2011)

Disadvantages

- Incurs high operation expenses due to the energy needed for pumping, labour and relatively large investment in equipment: sprinklers and pipes (HOVE 2011)
- Sensitivity to wind, causing evaporation losses (HOVE 2011)
- The unavoidable wetting of foliage in field crops results in increased sensitivity to diseases (HOVE 2011)
- Debris and sediments can cause clogging
- Capital cost is high with greater operational costs due to higher energy requirements (HOVE 2011)

References

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For further readings, case studies, awareness raising material, training material, important weblinks or the related powerpoint presentation, see www.sswm.info/category/implementation-tools/water-use/hardware/optimisation-water-use-agriculture/sprinkler-irriga