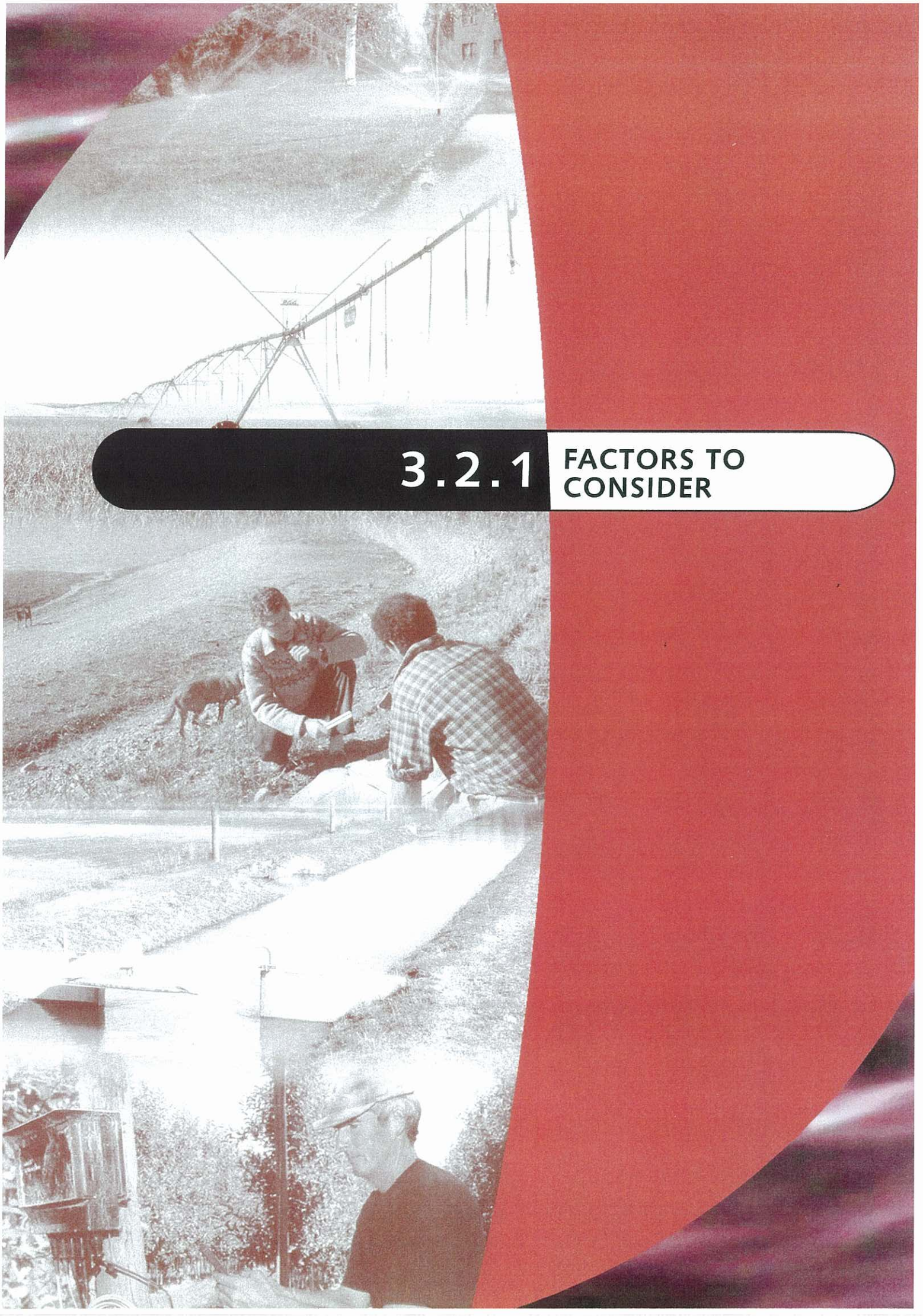

3.2.1 FACTORS TO CONSIDER

Physical factors

When selecting an irrigation system, there are many physical factors that should be taken into account. The most significant factors are described below. It is important to find out how each of these factors relates to your specific situation.

Farm layout

Farm layout is usually the biggest issue after price when selecting an irrigation system. The golden rule for efficient irrigation is to design the farm around the irrigation system, not the other way around. This means, if necessary, moving buildings, taking out trees, shelter belts, or fencing, etc, because you only do it once. Fast growing shelter trees can be replanted. Water races can be re-directed. Paddocks can be re-fenced. Power lines can be moved.

However, overall farm shape and fixed boundaries or obstacles such as power pylons can limit system choice. Some irrigation systems cannot be used efficiently on odd-shaped areas. This does not mean that these systems should not be used on such properties. They can be used to irrigate a large percentage of a property, and the remaining areas irrigated with more flexible systems. It is however usually better to keep to one system type and to only use multiple system types if absolutely necessary.

Effect of wind

The biggest problem with irrigating with sprinkler systems in windy conditions is that the uniformity of water application is seriously affected. Some areas will get too much water, while others will get too little. Wind can also blow some water away from the area that is being irrigated – for example, onto adjacent roads. Evaporation is also higher in windy conditions.

Systems that discharge water high into the air, such as high pressure guns, are usually most affected. Systems that discharge water under low pressure close to the ground – such as booms or centre-pivots using drop tubes, long laterals, K Lines or micro sprinkler systems – are usually least affected. However, these low pressure systems can also have high application rates and infiltration rate problems. Surface irrigation or drip systems are not generally affected by wind.

Animals

Some systems can be operated while animals are in the paddock. With sprinkler systems, care must be taken to ensure that animals entering a paddock are not thirsty, as the animals may try to drink from the sprinklers and break them. This can be an issue with K Lines. It is unwise to have animals, particularly sheep, in paddocks where centre-pivots or lateral moves are operating, because they tend to sleep in the wheel tracks and can get run over.

Catchup ability

Catchup ability is important where water supply restrictions are likely, particularly on river-fed systems, or on systems with limited system capacity. Systems on long rotations, such as travelling irrigators or border-strip systems, usually have poor catchup ability, because when water comes back on, it takes the length of the rotation (or half that time if machines are shifted twice daily) to get water back onto all paddocks. Systems such as fixed centre-pivots or other permanent systems have good catchup ability, because they can be set to apply some water to the full area quickly.

Crops

Some systems are suited to watering only certain kinds of crops, partly because of the system's physical operation within crops and partly because of the effect on the crop itself. Movable irrigation systems can damage crops through wheel tracks of the irrigation machine, wheel tracks of vehicles used to move the machine, and hose drag damage. Sacrifice strips may be required. Some systems cannot physically be moved through some crops. For example, K Line cannot be moved through tall crops. Contracts for supply of some crops can only be obtained if specific irrigation system types are used. It is vital to check with the purchasers of crops before choosing an irrigation method to ensure that the selection will be suitable.

Energy source

Although the energy source (electricity or diesel) is more of an economic issue, the location of an energy supply may influence the type of system used, if external energy is needed to drive a system. It may be better in some cases to choose a system that operates without additional energy requirements. If a gravity supply is available, system choice may be limited by the amount of pressure available.

Topography

Although most irrigated farms are on relatively flat ground, the ability to operate on sloping ground may be an issue. Factors to consider are the physical ability of the system to operate on sloping ground and the potential for runoff. Systems with low application rates or the ability to apply small depths of water are preferred. These tend to be permanent solid set systems, hard hose guns, pivots or K Line. Travelling booms and winch-type guns operate better on more even grades.

Water supply

The nature of the water supply affects system choice. The delivery schedule and quantity available may limit the type of system that can be used. Water supply reliability affects system capacity and the need for catchup ability. Water quality (chemical and/or suspended solids and sand) may also be significant, particularly for systems with small nozzles, or drive or control systems containing small ports.

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Economic factors

When selecting an irrigation system, the cost of the system is usually uppermost in farmers' minds. Initial capital cost, however, is only one of many economic factors to be considered. Some of these factors are described below.

Annualised costs

This is the annual cost of paying for and operating the irrigation system. It should include the annualised cost of the initial investment and ongoing costs such as fixed and variable energy charges, maintenance, labour and any other item that is going to result in a cash outflow during the year. It is important that these costs are closely explored when comparing one system with another; looking just at up-front capital costs is not sufficient for making an informed decision.

Capital investment

This is the up-front cost of the system. It generally includes the cost of the water supply, wells, power reticulation, pumps, mainlines, irrigation machinery and associated equipment such as tractors or farm bikes that may be needed as anchors or to move irrigators.

The initial capital cost of an irrigation system is usually substantial. Higher-cost systems tend to utilise modern technology to apply water more efficiently and also use automation to reduce the labour requirement. It is important to consider both initial capital investment and ongoing operating costs before making a decision.

Efficiency

Economic efficiency is primarily a function of the amount of production obtained versus the water and energy used. Both water use and energy use depend primarily on how evenly water can be applied and how well the system is managed. Application efficiency, which is heavily influenced by distribution uniformity, is one of the key determinants of economic efficiency. On systems with low application efficiency, you may have to apply significantly greater amounts of water to obtain a given level of production.

The most important aspect of economic efficiency is good system design. Systems that are poorly designed, with, for example, low application efficiency, will always be inefficient. Systems that are well-designed at least have the potential to be operated efficiently.

Energy costs (fixed and variable)

The energy input into irrigation systems in New Zealand normally refers to electricity required for pumping, although centre-pivot and lateral move irrigators also require an additional energy source for propulsion.

Be aware that fixed supply charges may be as much as the annual energy charges, so there are advantages in minimising motor sizes to reduce both supply and energy charges.

Operating pressure can give you an indication of the cost of operation where pumping is involved. In general, the lower the operating pressure, the lower the energy cost. Some low pressure systems can, however, be inefficient in other areas. For example, boom irrigators or large centre-pivots can be fitted with low pressure spray nozzles to save energy but could suffer from high application rates and lower application efficiency, requiring longer operating times. It may be better to use sprinklers that operate at slightly higher pressure to obtain higher overall efficiency and trade that off against higher energy charges.

Gravity-fed systems, whether they are surface irrigation or spray irrigation systems, have zero energy requirements, but if water is applied inefficiently, the performance of the whole system will suffer.

Effective life

Effective life of a system is related partly to reliability and partly to service availability. Irrigation systems usually last for many years. Low-cost systems generally do not last as long and may need replacement or major repairs after a few years, especially in harsh conditions.

Higher-cost systems may have a long life, but where they employ new technology, could become obsolete. This is particularly true for imported equipment, where spare parts may not be available after ten or fifteen years.

Labour costs

The labour required to operate irrigation systems varies enormously. Fully automated systems can reduce the labour required for daily operation to a few minutes per day. However, automated systems cost more, and depending on the system, can have a significant labour requirement for maintenance. The capital cost of automation should be weighed against the labour cost, including maintenance, to obtain a comparative cost.

Remember to allow for the cost of supervision and management in your labour calculations.

Land value and availability

Some systems are able to irrigate all of the land in a property, while others may not be able to do so. For example, hard hose guns can usually irrigate irregular areas, while centre-pivots cannot. Hard-hose guns, however, usually cost more to operate than centre-pivots and can be less efficient in windy areas. However, watering the corners of a centre-pivot area may require the installation of a much higher cost system. The additional production gained by watering these corners should be traded off against the cost of watering them. It some cases, it may not be economic to water these corner areas. The decision is often made on the basis of land value and availability.

Purchase and delivery

Terms of purchase depend on each individual's financial situation. Some people have sufficient funds available for outright purchase, but it is more common to borrow funds to finance the development. Perhaps the development can be spread over several years. Some systems can accommodate this approach, while others require the majority of capital investment in the first year.

The supply company may be able to offer attractive financing or payment terms. Guarantees are another factor that may influence your decision.

The time of delivery is also important to consider. You may be working to tight deadlines, and one company may be able to offer better delivery arrangements than another.

Reliability and service

All systems require repairs and maintenance, though some require more than others. As systems age, the money and time spent on repairs and maintenance increase, and may become a significant part of the total running costs of the system. In addition, breakdowns can result in serious loss of production, particularly if they occur at the peak of the season.

Before purchasing an irrigation system, find out how reliable the system is, how much maintenance is required, and how many years of service can be expected from the system. Talk to existing users of equipment about its reliability and about whether service is available. Find out how much of the maintenance can be carried out by farm staff, without the need for trained service technicians.

Poor water quality due to sand, organic materials, precipitation of solids, and iron in the water can have a significant effect on system life and reliability. It is important to choose system components appropriate to the quality of water.

Avoid irrigation companies that cannot commit to servicing systems within a few hours, or in more serious cases, a few days. Also, avoid companies that are not likely to be in the business for the long term.

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Social factors

Social factors are often ignored when selecting an irrigation system. They can, however, have a significant impact on the success or failure of irrigation. Some of the social factors that should be taken into account when selecting an irrigation system are listed below.

General acceptance

Some irrigation methods are not "politically acceptable" in some areas. It is prudent to find out what is acceptable and what is not in your area. For example, border-strip irrigation is viewed by some water managers as inefficient, even though it can achieve very competitive efficiencies when it is designed correctly. Public perception can have a strong influence, particularly in water-short areas, on what you are advised to do or not to do.

Health and safety issues

Although irrigation systems utilising clean water are not usually seen as a health issue, safety is extremely important. Some systems are large, and used incorrectly by untrained staff can pose a risk to operators or others. A common danger is the movement of large boom irrigators under power lines; extreme care must be taken to prevent irrigators touching lines.

A potential problem also exists if irrigators with large jets spray water onto roadways or where wipe-off water from border-strip systems floods roadways. If these problems are likely to occur, it may be better to choose a different method of irrigation.

Labour skills

When selecting an irrigation system, you should find out what time and skills will be needed to safely operate the system, and how much maintenance is likely to be needed. Systems that require a high degree of skill to operate should be viewed with caution, as finding reliable people to do the job can be difficult. If one skilled person is dedicated to operating the system, it may be acceptable. It is not a good idea to use untrained staff to operate such expensive equipment. You should find out whether suitable, reliable labour is available. In some areas of intensive irrigation, it is possible to contract professional irrigation system operators to maintain and operate irrigation systems.

If reliable skilled labour is likely to be difficult to obtain, it may be worthwhile considering systems that can be automated to remove or reduce the labour requirement. A word of caution, however: highly automated systems are inherently more complex to maintain, and you must make sure that suitable service and support are available.

Potential for vandalism

Vandals can create havoc with irrigation systems. Where vandalism may be a problem, it is wise to use vandal-proof technology or, at the very least, lockable control centres and pump sheds. Public turf irrigation systems are most prone to vandalism, and the use of vandal-proof pop-up sprinklers or buried drip systems is advised.

Resource Management Act issues

Resource Management Act issues are usually associated with obtaining a water supply. However, the Act also requires that water is used efficiently and does not have unacceptable adverse effects on the environment. Application efficiency must, therefore, be considered. As it can vary from one system to another, an understanding of its implications on obtaining consents is necessary. Another issue that may have to be taken into account is irrigation's effect on nitrate or bacterial contaminants in groundwater.

Personal preference

Even after you have done your investigations, there may not be enough difference between systems or quotes to make your decision obvious. It may come down to personal preference, which companies or people you feel most comfortable dealing with, or just plain gut feeling. Regardless of how advice is obtained, the final decision is yours.

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Border-strip irrigation

Application rate	Not applicable, as surface is flooded
Application depth	80-200 mm or higher
Distribution uniformity	Variable
Labour requirement	Low
Hydrant pressure	Not applicable
Capital investment	Medium
Reliability & service	Good with regular maintenance
Effective life	Can be long, up to 40 years
Enterprises	Good for pasture and very limited range of crops
Damage to crop	Not applicable
Watering irregular areas	Good
Effect of wind	None
Acceptance	Varies, very few new systems being installed
Fencing	Easy – important that headraces are fenced
Shifting	Not applicable
Shelter	Easy to arrange shelter pattern around layout

Border-strip irrigation was formerly the traditional method used on most community irrigation schemes in New Zealand. Today, the number of new systems being installed is very low, partly because inadequate water supplies are available, and partly because the cost of construction on uneven soils is high.

Although the method is often considered to be an inefficient method of irrigation from a water-use perspective, it can, with good design on suitable soils, be as efficient as some spray irrigation systems. The use of laser levelling has improved the efficiency of the newer systems and has been used with considerable success. Its low labour requirement, long life and simplicity make it an attractive method of irrigation where pasture is grown and where an adequate gravity-fed water supply is available.

It is suited to only a small range of crops, and where frequent cultivation is required, the borders have to be reformed every two years.

It is important to keep headraces clear of weeds by spraying them or close grazing them with sheep. It is also vital that headraces are fenced to minimise damage by stock.

Photo by Colin J Reid

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