# VIRTUAL FENCING APPLICATIONS FOR DAIRY PRODUCTION

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The majority of Australian dairy herds graze pastures as their primary sources of energy. This pasture base has varying growth rates over seasons. Pasture allocation is one of the key drivers of profitability within the industry. Fences are strategically placed to allow effective animal management with access to the pasture paddocks normally provided along fenced lane-ways. Fences are also used to prevent cattle accessing other sensitive areas on the farm. Depending on the farm layout, fences can follow contour lines, or in irrigation layouts, check banks and channels. Another parameter used to determine where the fences are placed is herd size.

Fence types used vary depending on the history of the farm and the attitude of the farmer. Historically, boundary fences have consisted of up to six plain wires held in place with either hard wood or treated pine posts, spaced six to ten meters apart with droppers in between. This style of fence is expensive to install, costing an average of $150 per metre (Rouda, 1999).

To reduce costs, over the past 20 years an increasing number of dairy farmers have started adding single or multiple wire electric fencing to subdivide their farms into manageable areas. Electric fencing is far cheaper to install (average $1.50 per metre) but its operating costs are high. Rouda (1999) reported the operating costs for an electric fence designed to contain an average herd size of 538 cows was close to $23,000 per annum when periodic equipment upgrades and regular labour requirements were factored into the equation.

Given the variability of pasture growth rates and increasing grazing herd sizes, the use of fixed, permanent or semi-permanent fencing structures is a genuine limitation to an industry continuously striving to stay competitive. Dairy farmers require a fencing system that can be truly flexible and easily adjusted to allow the herd varying grazing areas. It is therefore not surprising the concept of virtual fencing really excites the imagination of forward thinking dairy farmers.

Virtual Fencing (VF) is an innovative tool for grazing animal management. Once fully developed VF technology will have immediate applications for the dairy industry. The current basic conceptual VF system is based on a radio-wire type fence that radiates an electromagnetic field to create an exclusion zone and an on-animal receiver that will pick up this field within a defined range. Animals are trained to alter their direction of movement in response to audio-electrical stimuli delivered by the on-animal receiver. In addition, a programmable remote herding vehicle (RHV) equipped with a transmitter may be used to create a mobile

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inclusion zone for moving animals around. The virtual exclusion zone is created using a single radio wire hung on two to three metre high posts, well out of the way of farm machinery and/or river flooding. As animals come within a certain distance of the radio wire they are signaled to turn around and move in an opposite direction. Conversely, the virtual inclusion zone is created using animals equipped with the same receiver device configured to provide an audio-electrical stimulus once an animal begins to move outside of the range of the electromagnetic field transmitted from a mobile RHV. In this mode, the animals are encouraged to stay within a set distance of the RHV. Furthermore, an RHV can be remotely programmed to move its assigned animals to any location at a given speed. The various operational modes of the current conceptual models are graphically presented below in Figures 1 through 4.

In view of the rapid development in the GPS technology and its imminent incorporation in mobile telephony, it becomes an attractive alternative approach for the establishment of VF. It is envisaged that such an approach will be more cost effective in the long run as well as being able to achieve a consistent boundary resolution. As such, incorporating a programmable GPS-compatible chip into the on-animal receiver device will eliminate the need for both the radio fence and the remote herding vehicle as directors. In principle, animal movement could be keyboard orchestrated via satellite or terrestrial communication by altering the GPS coordinates. Further, the on-animal "tag" would ideally contain the necessary electronics to support the National Livestock Identification Scheme (or the advanced Electronic Livestock Passport) and milking parlor management.

The concept of VF was pioneered in the US by researchers driven by the need for a cheaper means for keeping cattle away from sensitive river frontage (Quigley *et al.* 1990; Tiedemann and Quigley, 1994). Keim *et al*. (1994) investigated the effect of audio-electrical diversion on cattle grazing behaviour and stress physiology. They found animals controlled by conventional fences selected diets higher ($P<0.05$) in crude protein than those subjected to audio-electrical diversion but no differences ($P<0.10$) in body condition or serum hormones levels (used as physiological stress indicators) between the two groups were observed.

The success of VF will depend on further investigation being conducted in two areas; animal behaviour (testing animal welfare and conditioning to invisible barriers), and prototype equipment development. Specifically we need to investigate the feasibility of using GPS to define grazing boundaries and the possibility of incorporating the information from satellite pasture monitoring technology to the VF environment. Most importantly we need to establish the long-term cost effectiveness of VF technology over the single wire electric fencing systems commonly used on dairy farms.

Attempts to establish a national consortium of technology developers between 1999 and 2001 revealed commercial players were reluctant to fully engage in the

development of a technology still at the conceptual stage. The funding received to date has been provided by the Western Australian state Government in partnership with Land and Water Australia, Environment Australia and the Natural Heritage Trust. These State and Commonwealth funding sources are unwilling to further invest unless the livestock industry groups provide significant contributions towards the development of VF, which they long recognized to be beneficial to both intensive and extensive livestock production and profitability. We are therefore adamant that unless the livestock industries of Australia unite to provide the necessary R&D funding for the development of VF, the benefits to Australian producers will never be cost-effectively realised.

## REFERENCES

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