Farming Technology Solutions

Project Overview

REMOTE INFORMATION MANAGEMENT SYSTEM (RIMS)

Error Resilient Radio Transmission of Wavelet Encoded Images

Benefits to Extensive Livestock Producers

- ***Better decision making and production to precise market specifications***
  by providing managers with immediate information on animals trapped in suitably equipped yards.
- ***Peace of mind and rapid response capability***
  through a visual picture (in real time) of what is taking place at the trapping yard and assurance the animals have adequate supplies of potable water
- ***Higher returns***
  as a result of higher premiums being paid for properly processed stock and e-commerce trading
- ***Natural resource protection***
  managers can monitor feral and other undesirable herbivore populations to facilitate there removal

Synopsis:

Very little technological advances have been made in rangeland production systems in recent decades. It could be argued that mustering by light aircraft was the last great advance in reducing input cost and increasing productivity. Efforts need to be directed at modifying and applying (not necessarily developing) the latest technology within a grazing industry context. The areas of greatest interest are the efficient use of water, and the introduction of remote monitoring and control technqiues to increase productivity and reduce input costs. The ultimate goal is to enhance the competitiveness of rural industries in the context of globalisation. The adoption of automation is likely to improve the rural life style by doing away with some of the labour-intensive routines. The application of automation over large remote sites will need an appropriate communication infrastructure to link together the various sites. For a simple application, such as switching on a water pump in a remote water point, a purpose built system may be put together using some off-the-shelf components. Such an ad hoc approach may satisfy the immediate need but is unlikely to support future additional applications and features without major system reorganisation or replacement. A more systematic approach is needed to effectively introduce modern information technology to the rural industries.

The challenge here is to come up with a cost-effective wireless communication infrastructure over a very large coverage area. The proposed system must be able to cater for a diverse range of

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applications, such as remote monitoring and control with or without video, using a standard set of modular components. The capacity for additional applications and features must be a key design factor. Bearing in mind the importance of getting-in-touch with the outside world, any proposed system should also be able to be linked to public switched network, possibly via a satellite communication link.

It is proposed that an in-depth feasibility study be carried out to investigate an effective and economically acceptable approach of introducing modern information and communication technologies to enhance the rural pastoral industry. Central to this approach is the establishment of a low-cost terrestrial radio based network for linking several remote sites. Also, a computer software package, which includes user interface and database, needs to be developed to interface the communication network with the end users, who will then be able to control the various activities remotely, and to make appropriate use of the collected data stored in the database. One example scenario is the remote monitoring and control of water points. In this case, the most basic requirement will be for the water level to be remotely monitored, and the information then relayed by radio back to the central/homestead computer. Depending on the sophistication of the software and the requirement by the user, a control signal may be automatically transmitted back to the remote water point in response to the monitored water level to switch on the water pump. Alternatively, a warning signal may be flashed to remind the user to send a control signal to switch on the pump. In a more sophisticated set up, a video surveillance camera may be added to allow the user to view the water point without the need to change the radio equipment. Furthermore, by applying a few more remote sensors, such as wind speed and light sensors, the electrical power for water pumping can then be derived from an integrated wind/solar-diesel generator. Also, at some stage, there may be a need to send information derived from radio tags attached to individual animals back to the central computer database. This will call for an interface unit to be added to the system to connect between the tag reader and the radio equipment. It is envisaged that the radio network will have sufficient capacity so that additional peripheral sensors or control units may be added to the system at a later time. Additional features, such as voice, may also be included as an optional feature of the network. Moreover, for any proposed system to be accepted by rural users, it has to be reliable and cost effective, in terms of capital and maintenance costs, and user friendly. These requirements present great challenges to the system developer.

The following four major activities have been identified for the proposed feasibility study:

1. To derive a communication protocol, which is simple to implement and flexible to cope with different applications involving different types of data as well as compressed digital video. Initially, a survey of some existing communication protocols will be carried out to examine the possibility of adopting or modifying one of them for the proposed application. It is to be noted that many of these protocols are proprietary and are restricted to handling relatively low data rates.

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2. To develop a simple error tolerant coding scheme to support the radio transmission of highly compressed digital images. Such a scheme will initially be used for remote monitoring of water points.
3. Once a suitable communication protocol has been identified or developed, a software package has to be written to implement the protocol and database.
4. Finally, a prototype system, consisting of mainly off-the-shelf components, will be set up to demonstrate the operation of the system. Field strength measurements will be required to establish the link budget.

RIMS Budget

Participating Organsiation	Commitment Dollars
Department of Agriculture WA	5,000
Curtin University of Technology	130,000
Dairy Research & Development Corporation	20,000
Industry host	10,000
Yet to Determined	270,300
TOTAL	435,300

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Project Overview

ELECTRONIC PASSPORT FOR TRADER LIVESTOCK (ELP)

Benefits to the producer and others along the supply chain include:

- Direct and immediate access to vital production information for management decisions and providing on-site, password-protected data update capability.
- Highest product premiums as a result of comprehensive quality assurance.
- Increased efficiency and lower production costs by reducing the amount of time and effort required to register and update central database records (a characteristic of read-only tags).
- Reduced risk of distorted or corrupted information that may occur inadvertently every time information is sent and/or accessed to/from the central database (a risk associated with read-only tags).

Synopsis:

All indicators are suggesting that the use of the National Livestock Identification Scheme (NLIS) will soon become standard protocol across Australia. Furthermore, in response to consumers' demand for health and quality assurance, international market trends suggest that historical information on all meat products have to be made available to ascertain its suitability for consumption.

The development of this proposed **ELP** system basically represents the accelerated evolution of the technology developed for the National Livestock Identification (NLIS). The current scheme, designed to cater primarily for regulatory purposes, requires a central data bank be maintained and updated every time animal ownership and medication status are changed. Further, this transfer of information from the operational site to the central database, albeit via electronic medium, will not be immediate. Its ultimate success and effectiveness is totally reliant on operator compliance and the time between a specific operation taking place and the information reaching and being processed at the central database.

The proposed ELP identification system involves the development of *smart* identification tag that can passively transmit, receive and store information on the livestock. Data modification will be password-protected for added security. ELP technology will streamline the recording of a multitude of production parameters/traits and provide each segment of the supply chain (from the livestock producer to the meat processor) with immediately available and updated historical information, without having to refer back to the central database. Each time the ELP tag is modified, changes are stored in its memory immediately. For regulatory purposes, the ELP tags may be scanned periodically by the readers with the information validated at the central databank. These would typically be located at sale yards, shipping ports and abattoirs.

The proposed ELP identification system is a component of RIMS.

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ELP Budget

Participating Organsiation	Commitment Dollars
Department of Agriculture WA	31,000
Curtin University of Technology	144,000
Industry host	20,000
Yet to Determined	**379,000**
TOTAL	**574,000**

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Farming Technology Solutions

Project Overview

TECHNICAL FEASIBILITY OF VIRTUAL FENCING (VF)

Benefits to Livestock Production

- ***Greater control over free-ranging animals***.
  Producers will know where their animal are or move them to where they should go with a few strokes of the key board.
- ***Maximum grazing efficiency***
  through the utilisation of satellite intelligence to fully exploit seasonal conditions resulting in a fifty percent increase in animal productivity.
- ***One hundred percent increase in vegetation productivity***
  over a 15 to 20 year period in semi-arid rangelands as a result of uniform and proper use of natural resources.
- ***Maximum protection of natural resources***
  custom designs that take full advantage of existing property infrastructure
- ***Competitive pricing with a benefit to cost ratio in excess of 5***
  In terms of mustering alone, the potential savings to production costs could be as high as $110,000 per annum.

Synopsis:

Virtual Fencing is an innovative alternative method for controlling grazing animal movement that does not involve conventional wire fencing. Once fully developed VF technology may be applied to all classes and species of grazing animals. A basic VF system would include a radio-wire type fence that transmits signals to create an exclusion zone, a programmable remote herding vehicle (RHV) that transmits signals to create an inclusion zone and the on-animal receiver device that complements both of these virtually fabricated zones. Animals are trained to alter their direction of movement in response to audio-electrical stimuli delivered by an on-animal receiver. A virtual exclusion zone (for example along a stretch of river frontage) is created using a single radio wire hung on posts along the riverbank. As animals come within a certain distance of the radio wire they are signaled to turn around and move in an opposite direction. The virtual inclusion zone is created using animals equipped with the same receiver device configured to receive signals transmitted from a mobile RHV. In this mode, the animals are encouraged to stay within a set distance of the RHV. If they drift too far away from it, they are encouraged to turn around and keep within close proximity. The RHV can be programmed by the manager to move its assigned animals to any location at a given speed. It can also receive seasonal condition intelligence via satellite and adjust its travel route accordingly.

Between 1996 and 1998 DAWA, LWA and Environment Australia (EA) jointly spent $150,000.00 on a preliminary study to test the market feasibility of developing VF in Australia (Rouda,1999). This work resulted in the development of a conceptual design for VF. A PCT application was lodged in which DAWA owns 60% of the VF patent and LWA and EA own 20% each. This

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application recently entered the national phase with full applications being lodged in Australia, New Zealand and USA.

The concept of the VF scheme is relatively simple. It involves the use of an electromagnetic (EM) field to establish either an exclusion or an inclusion zone for controlling movements of grazing animals fitted with an appropriate receiving device. However, the realisation of VF depends greatly on the feasibility of establishing a cost-effective means of generating a controlled EM field with well-defined boundary limits in a very large unguided environment. This calls for an R&D program, adequately funded over a period of two years, to carry out the detailed technical feasibility study. It is important to have a systematic study, which will lead to the formulation of design models and guidelines essential for future product development. One vital task will be to determine the achievable accuracy for the virtual boundary limits. This exercise, if carried out properly, will also and build up human resources with specialist technical skills vital for designing and developing VF products.

For the R&D program, a graduate engineer, or preferably a post-doctoral research fellow, with experience in the EM area is to be engaged to do an in-depth analysis into possible ways of establishing a controlled EM field over a specified area. This will be carried out most cost effectively using extensive computer simulations. It is likely that innovative ideas will be forthcoming from this part of the R&D program, and this work is to be supervised and guided by Curtin personnel with the appropriate experience. It is envisaged that this initial study will take about six months to come up with design proposals, which warrant confirmation by field tests. At this stage, specialist equipment may be needed for carrying out the field tests. Although some electronic devices are likely to be custom designed and implemented for the purpose, off-the-shelf modules will be used whenever possible to save time and money. The field tests will involve additional part-time personnel, including postgraduate and undergraduate project students. Such tests, which require extensive planning and are time consuming, will need to be carried out on several sites with different environmental features. The measured data will be compared with computer simulated results in order to formulate relevant design models for different terrain and they will provide a useful performance prediction tool. Once the technical feasibility on the controlled EM field is established, hopefully within about twelve to fifteen months into the project, a second program can begin to investigate the effectiveness of the VF scheme with grazing animals. In this study, the reactions of grazing animals to audio-electrical stimuli after entering into an exclusion zone will be investigated. Such a study will involve the collaboration of animal behaviour specialists and engineers to arrive at the proper design parameters for the on-animal electronic device.

Once the fundamental questions on the VF design have been answered, the next phase will be to seek capital investment funding (estimated at $1.5m) to support the pre-production equipment design and development.

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Project Overview

VF Budget

Participating Organsiation	Commitment Dollars
Department of Agriculture WA	250,000
Land & Water Australia & Environment Australia	48,000
Curtin University of Technology	45,000
Industry host	30,000
Yet to Determined	**239,000**
TOTAL	**612,000**

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Farming Technology Solutions

Project Overview

NIPPIDRINK - AN INNOVATIVE STOCK WATERING DEVICE

Benefits to producers

- ***Better Animal Performance***
  as a result of livestock having continuous access to high quality water, free of algae and other contaminants.
- ***Reduced production costs***
  through an estimated yearly saving of $100-200 per trough, currently expended on maintenance and routine cleaning of current water delivery devices on extensive pastoral properties.
- ***Reduced water wastage***
  resulting from evaporation and the routine empting of troughs during the cleaning process (estimated at approximately 6,200 litres per year for each standard 3-metre trough).

Synopsis:

Research into novel watering devices for free-ranging stock has not progressed significantly since the introduction of the watering trough. This system, though functional, is not very efficient as water is lost through evaporation and routine cleaning (estimated at approximately 6,200 litres per year for each standard 3-metre trough), and troughs require constant monitoring and maintenance to ensure they operate effectively. Even if innovative technology soon becomes available to remotely monitor water troughs, producers will still need to visit the trough to clean it. Trough maintenance costs producers an estimated $15,600 –20,800 every year, and if this could be reduced, profitability would increase by an estimated $10,000 annually. Further, Nippidrink may greatly enhance the control and dispensing of nutritional/medicational products and soluble lures (aniseed/salt) to keep stock on waters equipped with trap years (Total Grazing Management System) all year round, even when there is large amounts of paddock surface water. Nippidrink may also promote the control of feral cats to reduce pressure on biodiversity as nipple height may prevent cats from exerting adequate nipple pressure for water let down.

In April 2000, the Nullarbor Eyre Highway Land Conservation District Committee received PIRD funding to develop a innovative watering device that ensured grazing livestock had free access to high quality water, free of algae and other contaminants and that animals would learn to use with minimal human intervention. LCDC members worked closely with scientists at Muresk Agricultural College, Curtin University and DAWA, to design a novel water delivery device for grazing livestock (Design I). A small prototype system for 10 sheep was built at Muresk and pen-trialed for 5 days to establish operational protocols, such as animal training requirements. A supervised college student undertook this work. A functional system that could accommodate up to 30 sheep at a time was then piloted in a small paddock close to the homestead at Noondoonia Station. The first

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phase of this pilot lasted 7 days and involved a flock of 50 sheep that were pre-conditioned to use the system, as determined in the Muresk protocols. Numbers were gradually increased until the flock size reached 100 to ascertain if sheep learnt to use the system by observing other sheep and also identify the optimal size of the device per hundred head of sheep. The same Muresk student worked side by side with pastoralists to monitor and document stock condition, behaviour and water flow rates (intake). This unit was further modified (nipple height, configuration, structural support; Design II) and tested on Fraser Range Station. Design III has been built but has yet to be tested on animals. Before this is done, robust scientific measurement and more fine-tuning is required.

Nd Budget

Participating Organsiation	Commitment Dollars
Department of Agriculture WA	19,000
Curtin University of Technology	16,000
Producer Initiated Research Demonstration	6,000
Industry host	15,000
TOTAL	**56,000**

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Project Overview

BIOLOGICAL PURIFICATION OF STOCK WATER

The Bioclean Stock Water Trough

Project Objectives:

1. To identify and trial the effectiveness of various biological agents as water purifiers in traditional stock water storage vessels (troughs, turkey nests and conventional dams)
2. To investigate the cost-effectiveness of using bio-technical agents as water purifiers, in terms of reduced management costs
3. To extend the findings of this trial to other producers in the southern rangelands

Synopsis:

Watering points on stations are commonly composed of a water supply (bore, well or drainage channel), a storage vessel (tank or dam) and a watering trough. High operating and maintenance costs are associated with this method of watering animals – in terms of time, labour and mechanical resources. During summer months, when water is in high demand by grazing animals, twice-weekly visits to station waters to clean troughs are needed. Trough cleaning is required to maintain water quality at an acceptable standard for stock consumption. As an average property has about 30 watering points, a significant proportion of station time (estimated at 50% during summer) and resources are tied up in conducting mill-runs. Trough maintenance costs rangeland producers an estimated $15,600 –20,800 every year, and if this could be reduced, profitability would increase by an estimated $10,000 annually.

The use of bio-technology in animal watering systems has been successfully used in Australia (Tasmania) and overseas (South Africa). Natural water-living organisms are placed within water points to maintain/improve water quality. Natural vegetation, possibly in conjunction with aquatic animals such as fish and crustaceans, develops a stable ecosystem within the water point that maintain water quality in terms of levels of dissolved oxygen, salt concentration and nutrient cycling.

This bio-technology concept may present a low cost, low maintenance means of ensuring animals receive high quality water. The frequency of visits to waters could be reduced, as trough cleaning would no longer be required on a twice-weekly basis. Biological water purification processes may also present a favourable return on investment for pastoralists given their low investment cost. Choosing the right biological agents suited to the WA rangeland environment and assessing their effectiveness and economic feasibility underpins the thrust of this project.

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Farming Technology Solutions

Project Overview

Bioclean Trough Budget

Participating Organsiation	Commitment Dollars
Department of Agriculture WA	20,600
Industry host	6,000
TOTAL	**26,600**

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Project Overview

GRAZING DIET ANALYSES USING NEAR INFRARED REFLECTANCE SPECTROSCOPY (NIRS) IN WESTERN AUSTRALIA

Project Objectives

1. To develop NIRS fecal analyses capability in Western Australia for the determination of diet quality attributes and botanical composition for animals grazing natural and improved pastures.
2. To provide livestock managers with a cost effective and reliable tool for tactical animal nutritional management
3. To establish best-practice/strategic nutritional management guidelines for livestock in WA.

Synopsis

The quality of diets consumed grazing animals has a profound effect on their productivity. Extended periods of nutrient deficiency (nitrogen, phosphorus and other essential nutrients) are often the cause of losses in animal body weight and condition, reduced feed intake and diet digestibility, and poor reproductive performance, all of which bite into the producer's profit margin. Managers are often faced with difficult and costly decisions as to when to start and when to stop supplementing these nutrients to their animals. Conventional methods of estimating nutritional attributes of grazed pastures are time consuming, costly and somewhat unreliable. Mr David Coates (CSIRO Townsville) has pioneered new technology that analyzes animal feces using Near Infrared Reflectance Spectroscopy (NIRS). This procedure has proven to be a quick, inexpensive and reliable prediction of grazing diet quality. Forage samples representative of cattle diets in northern Queensland and fecal samples from cattle eating such diets have been analysed to produce predictive/calibration equations. The range of dietary attributes for which preliminary calibration equations have been developed include crude protein, digestibility, neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL), grass and non-grass proportions, intake of digestible dry matter and rate of gain in growing cattle. Mr Coates has recently been granted additional MLA funding to progress NIRS and he is keen to see NIRS analyses extended to other regions across Australia. He has offered to provide the WA Chemistry Centre (who owns compatible NIRS equipment) with his calibration equations as a preliminary step towards a future on-going program of validation and expansion to increase the robustness of his current equations.

The prospect of collaborating with the CSIRO/QDPI researchers working on the current MLA funded work appears very feasible. The WA project will need to provide CSIRO with data on 60 diet/fecal pairs for them to expand their calibrations in return for us using their equations. Cross instrument calibration is possible and fairly straight-forward. The project will collect feces from animals fed identifiable (clipped) diets representative of those likely to be encountered in grazed

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pastures. Clipped pasture samples will then be analysed using classical chemical techniques and the results used to calibrate against the signals from fecal NIRS. Queensland workers have yet to obtain calibration data from saltbush and seeded pastures. Under the current MLA funded project there are several sites in Queensland, a few in the NT, one in SA ***but none in WA***.

It is anticipated that the WA Chemistry Centre will function as the commercial service provider for WA producers. The possible payment of royalties to the CMAE and/or others involved in the commercial development of this service provision in WA will be addressed during the course of formulating a the service's IP management strategy

This work is an extension and expansion of David Coates' NIRS work. This project is closely aligned to and is an extension of the PIRD project ***Supplementary Nutrients for Cattle*** *(Reference number 99/W01)* submitted to the MLA

Participating Organsiation	Commitment Dollars
Department of Agriculture WA	55,000
Curtin University of Technology	75,000
WA Chemistry Centre	120,000
Industry hosts	40,000
Yet to Determined	**350,000**
TOTAL	**640,000**

FTS Budget Summary

FTS Project	Total Budget	Funding Available	Investment Required
Remote Information Systems	**435,300**	**165,000**	**270,300**
Electronic Livestock Passport	**574,000**	**195,000**	**379,000**
Virtual Fencing	**612,000**	**373,000**	**239,000**
NippiDrink	**56,000**	**56,000**	**0**
BioClean Trough	**26,600**	**26,600**	**0**
NIRS in WA	**550,000**	**290,000**	**350,000**
TOTAL	**2,253,900**	**1,105,600**	**1,238,300**

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