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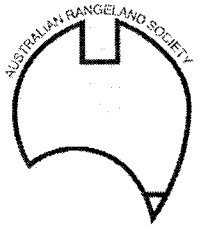

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DEVELOPMENT OF AN ELECTRONIC LIVESTOCK PASSPORT

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ABSTRACT

With rapid advances in electronic, radio and computer technologies, global electronic identification for livestock and companion animals is now technically feasible. It is particularly important for animal safety, farm management, disease control and prevention of fraud or theft. While international standards have been established, new devices are continuing to emerge with advanced functionalities and features. This paper proposes the use of Radio Frequency Identification Tags (RFID) with Read-Write capabilities for the development of Electronic Livestock Passports (ELP). In corporation with the remote information management system (RIMS) and the Remote Video Monitoring system (RVMS), the ELP will bring many benefits. Other related issues are also discussed in this paper.

INTRODUCTION

Based on year 2000 information from the Australian Bureau of Statistics (ABS 2000) and the Meat & Livestock Australia (MLA 2001), there were over 24.4 million beef cattle and over 75,000 properties with beef cattle in Australia. Of the total beef production, over 66% were exported at a total value of approximately $3.5 billion. On the world scale, although Australia only held 2.6% of the world's cattle inventory and produced 3.9% of the world's beef supply, it was the world largest beef exporter with a total exported carcase weight of over 1.3 million tonnes. On the other hand, the number of sheep and lamb flock exceeded 118.6 million with 50 million breeding ewes and 31 million young lambs. In terms of exports, the number for lamb, mutton and live sheep were approximately 111, 180 tonnes and over 5 million heads respectively. Australia produces 9% of the world's lamb and mutton supply and is the second largest exporter after New Zealand. The total values of lamb and mutton exports were $440 and $363 million respectively. The value of live sheep export was valued at $214 million.

It is obvious that the Australian livestock industry is an important economic pillar contributing to the welfare of the nation. However, the strong dependence on the global market also means that the producers are facing intense competition and the need to satisfy customers' demands for high quality products. In order to maintain high standards and efficiency, the industry must continually improve its operation and constantly evolve in order to survive. This can be considered in two aspects:

(a) Meeting International and National Standards and Requirements
(b) Improving the quality and yield through better production and management processes.

In the case of (a), International standards have been set by bodies such as the International Committee for Animal Recording (ICAR) and the International Standards Organization (ISO). ICAR is in the process of establishing international agreement governing the recording practices of animal identification. With respect to the use of RFID for animals, ISO has issued two standards, ISO-11784 and ISO-11785, concerning the code structure on the RFID and the technical concept on how information is being transferred. These have formed the basis of the National Livestock Identification Scheme (NLIS) in Australia. NLIS is a national program with an objective to provide permanent identification for individual animals, enabling them to be tracked through their life cycles. While NLIS is a voluntary national system, it is extremely important for the producers to meet compliance in the overseas markets. For example, NLIS will meet the European Union's (EU) requirement of traceability of all cattle slaughtered. In the state of Victoria, legislation has been in place that cattle born after 1st of January 2002 must be identified with a white NLIS Breeder Tag before they leave their property of birth. As from 1st January 2003, all cattle to be sold, stored and transferred between

Victorian properties must be identified with the NLIS tags. It is expected that similar legislation will be established in other states.

While a NLIS tag meets the standards and legislation requirements, the bottom line lies at the business interest of the producers or the farmers. It would be an additional economic burden if new technology does not improve the quality of the product and the profit margins. Hence, it is more important that NLIS or any new scheme must be able to improve the management process in order to lift the quality and profit. This is in fulfilment of point (b) above.

In this paper, the objective of better management is further expanded by the proposal of an Electronic Livestock Passport (ELP) system. Unlike the NLIS tag that only provides a read-only code, the proposed ELP utilises the Read-Write RFID technology. This allows a certain amount of information to be stored and read, updated and modified according to different requirements. The information will be stored in "safe-boxes" which are protected and encrypted in order to maintain the data's security and integrity. During different stages of the livestock's life cycle, different individual parties may access to different part of the tag's memory that is of relevance to their operations. This allows access to the information that is pertinent to the relevant party. Incorporating with other proposed communication system by Chung (2001) and video monitoring system by Jerrat (2001), the ELP provides an integrated approach to the entire production, sales and marketing process. The next section provides an introduction to RFID technology. This is followed by an overview of the NLIS. Finally a discussion on the proposed ELP system, its benefits and related issues. This paper aims at spurring the reader's interest on the development and the potential of deploying the next generation RFID device in order to lift the standard of the livestock industry to another new height.

RFID TECHNOLOGY

Radio frequency identification (RFID) technology was developed in the 80's for the purposes of tracking and non-contact access. It is primarily a system enabling automated identification, data collection and analysis. The wireless system allows contactless reading and overcomes many disadvantages of the bar-code system. It has essentially two devices: the tag and the reader. On the tag, it comprises an antenna that receives the radio energy emitted from the reader. The radio energy is then converted into electrical energy by the principle of electromagnetic induction. The tag then responses with the unique information that is stored on the tag. The reader receives the transmission from the tag and processes the information for subsequent uses. RFID tags are categorised according to the following features:

(a) Whether the tag is powered by an internal battery. Passive tags are those with no internal power source whereas active tags are those installed with an internal battery.

(b) Whether information can be updated on the tags. Read-only tags are those on which the information are fixed and cannot be altered. On the other hand, Read-Write tags allow modification of the data as required.

(c) The operating frequency range: Low-frequency range is between 125 to 134 KHz and mid-range at 13.56 MHz for smart cards and smart labels. High to very high frequency at 900 MHz, 2.45 GHz and 5.8GHZ are used mainly for toll standards. In general, lower frequency offers low cost, low reading range and low reading speed, whereas high frequency range provides higher speed, greater read range and the systems are more expensive.

For the purpose of animal identification, the ISO standard has adopted the low frequency (134 KHz), passive and read-only device. This is described in the next section.

NATIONAL LIVESTOCK IDENTIFICATION SCHEME (NLIS)

As promoted by MLA, the NLIS provides a number of key benefits such as (MLA 2001):

- Market access advantages.
- Information on individual animals to improve feeding and breeding decisions.
- Automated on-farm record keeping and improved on-farm decision making.

- Links with value-based marketing and industry programs.
- Improved vendor guarantees on residue and disease freedom.
- Ability to refine genetic selection and management skills to produce a higher value, more market focused product.

The basic concept is to apply the ISO-11784/11785 compliance RFID device to tag the animals. The identity of the animal can be read by either a fixed mount or a hand-held reader. The information collected will be used to create a record for each individual animal on a database or management software. Typical information on the database are weight, veterinary treatments, costs and paddock

An illustration of the arrangement is shown in Fig. 1..

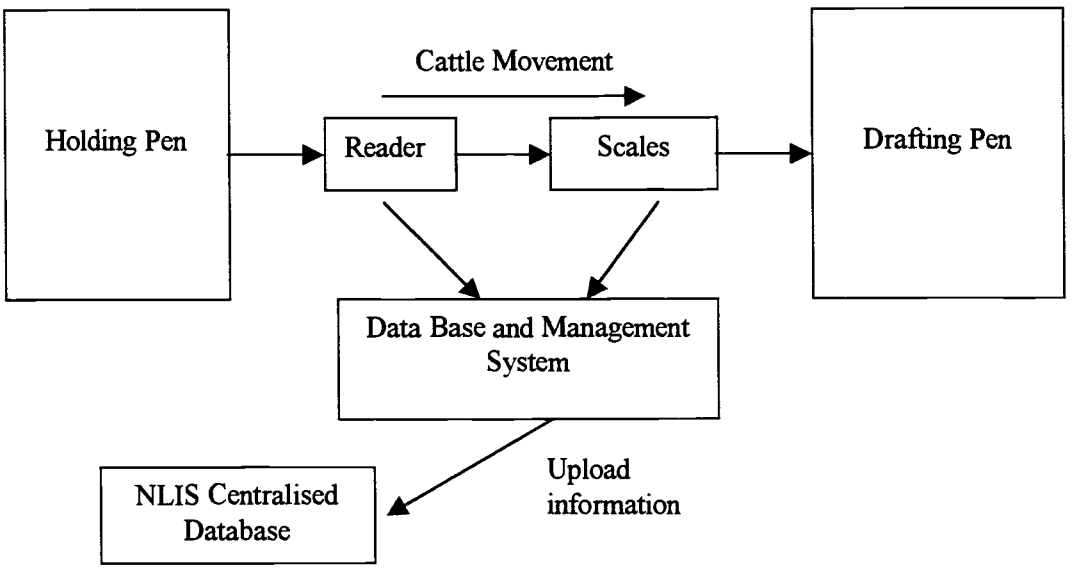

Fig. 1: NLIS System for animal identification and recording

PROPOSED ELP SYSTEM

While the low frequency based NLIS system satisfies the basic ICAR requirements, the advanced features of high frequency read-write RFID tags should be explored for better information management and system performance. First of all, differences between low and high frequency tags are shown in the table below:

Operational Frequency	Low Frequency (134 KHz)	High Frequency (13.56 MHz)
Read Range	Short to Medium	Medium to Long
Data Rate	Medium	Fast
Orientation	Not orientation sensitive	Orientation sensitive
Penetration	Through non-metallic medium	Less able to penetrate
Power Level	Low	High
Cost	Inexpensive	More expensive
Sensitive to noise	Yes	Less sensitive
Read-Write capability	Read only	Read-Write
Amount of Data	low	high

Table 1: Comparison between low and high frequency RFID tags

It can be seen that the high frequency tags offer better performance and capability in terms of data storage and speed. However, it has a main drawback in the reduced ability to penetrate if the tag is located inside the body of the animal. If ear tag instead of rumen bolus is used, this does not pose any problem in terms of data transfer.

On the other hand, the information in the NLIS database are limited to the following fields:

- RFID or NLIS number,
- the seller's Property Identification Code (PIC) /tail Tag number,
- the buyer's Property Identification Code (PIC)/Tail Tag number,
- the EU vendor Declaration number, and,
- the date of the transfer of ownership.

This does not provide any other information on the cattle apart from the ownership transfer history. Although additional data such as weight, linkage and vaccination history could be stored on the producer's management database, they are not available unless provided by the owner. Another issue is the integrity of the database as any additional information has to be updated manually. The idea of the ELP is to provide an on-the-spot management tool and to be integrated with the proposed RIMS and RVMS. As the frequency range is higher, the size of the antenna can be reduced thereby providing a more compact reader. With the availability of the RIMS, information can be directly exchanged and updated between the tags and the remote database instantly. The RVMS also provides an image matching to the identity of the cattle. Information which are normally stored in the management database could be mirrored on the tag and made available to users at different stages of handling. The reader can also be provided with an appropriate and friendly interface for more convenient data entry and retrieval operations. While there are doubts in the cost of the read-write tags, history has shown that economic of scale is often the determining factor in deciding the cost rather than complexity of the device. As the high-frequency tags at 13.56MHz are used extensively in automotive industry and other inventory applications, the price will definitely drop subject to adoption by the industry. Hence, the price factor is not foreseen as a barrier. The main issue is to develop an efficient management system utilising the next generation technology rather than limited by the less flexible devices. ISO has already assembled a New Work team, Animal Identification and Monitoring. It is expected that the proposed ELP will provide many new functions and applications.

CONCLUSION

This paper has proposed an Electronic Livestock Passport (ELP) for the identification and storage of management information on the animal. The NLIS has made the first step in utilising electronic technology to improve the operation of livestock industry in Australia. The next step will be the utilisation of more advanced technologies such as high frequency read-write RFID tags to enhance the operations further. By incorporating communication and video techniques such as the proposed RIMS and RVMS, the ELP will be an essential component in the next generation integrated management system for the livestock industry.

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