Journal of Animal Husbandry and Dairy Science
Volume 1, Issue 1, 2017, PP 38-52

Application of Radio Frequency Identification to Selection for Genetic improvement of Rural Livestock Breeds in Developing Countries

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ABSTRACT

This paper presents technical report on the application of radio frequency identification (RFID) systems to animal breeding and herd management. The proposal involve use of RFID transponders, readers and software and the planning of equipment, that had been tested both in the laboratory and in barns as documented by various authors. Electronic identification of animals could be exploited by farmers to select superior animal for breeding for genetic improvement. It will also provide opportunity to increase the accuracy of record keeping, herd management and most importantly when pedigree selection is desired for selection of superior animals for breeding. The merits of RFID system is the accuracy of records it provide for effective selection for livestock breeding and management. The application of RFID for herd management system where each animal carries RFID tag, allows each breeding activity to be monitored, sires and dams of progenies for accurate record keeping. The read identification data from the RFID tag carried by the mounted female animal is use to generate breeding activity data including the identification data of the mounted female, mounting male and timing data for each mounting. The herd management system is adopted to process breeding activity data output from the breeding activity monitors to generate herd management data. Radio frequency identification if employed will alleviate challenges of livestock producers to ensure animal identification, record keeping, plan mating, herd management and most importantly will improve selection response.

Keywords: *animal-identification, genetic-improvement, radio- frequency, selection*

INTRODUCTION

An animal identification by means of marking the body was first recorded 3800 years ago in the Code of Hammurabi to prevent thievery (Bowling *et al.*, 2008). Different methods of marking animals were used by Egyptians, Greeks, Romans, and nomadic people of Scandinavia, Asia, Africa and pre-Hispanic Americans for different purposes (Caja *et al.*, 2004). According to Bowling *et al.* (2008) and Vallat (2009), identification was initially applied to particularly valuable animals such as horses which were used by the Chinese postal system or by Roman charioteers. Following these early beginnings, animal identification and traceability have become widely recognized as essential tools for ensuring the safety of livestock products and facilitating veterinary disease surveillance and control (Blancou, 2001). Lately, animal identification of livestock had been extended to include breeding and production management, control of disease outbreaks, establishment of ownership, and requirement for export and consumer demands (Bowling *et al.*, 2008). Livestock identification and trace back system (LITS), which were introduced in some African Countries, for instance Namibia and Botswana over 11 years ago has largely failed to meet the expectations of both the Government of Botswana (GoB) and the beef sector (FAO, 2010). In Nigeria, Livestock identification and trace back system (LITS) are experiencing policy and implementation challenges. Therefore, this paper investigates the advantages and disadvantages of animal identification and traceability using electronic methods of livestock identification, as well as, challenges to Livestock identification and trace back system (LITS) implementation.

Radio Frequency Identification (RFID)

Radio frequency identification (RFID) is a technology that incorporates the use of electromagnetic or electrostatic coupling in the radio frequency (RF) portion of the electromagnetic spectrum to uniquely identify an object, animal or person. RFID is coming into increasing use in industry as an alternative to the bar code. The advantage of RFID is that it does not require direct contact or line-of-sight scanning.

Component of RFID System

According to Akhilesh *et al. (*2013) RFID consist of three components the Transponder, Trans-receiver, Herdsman's software (Data accumulator) (McAllister *et al.*, 2000). RFID system consists of three components: an antenna and transceiver (often combined into one reader) and a transponder (the tag). The antenna uses radio frequency waves to transmit a signal that activates the transponder. When activated, the tag transmits data back to the antenna. The data is used to notify a programmable logic controller that an action should occur. The action could be as simple as raising an access gate or as complicated as interfacing with a database to carry out a monetary transaction. Low-frequency RFID systems (30 KHz to 500 KHz) have short transmission ranges (generally less than six feet). High-frequency RFID systems (850 MHz to 950 MHz and 2.4 GHz to 2.5 GHz) offer longer transmission ranges (more than 90 feet). In general, the higher the frequency, the more expensive the RFID system. (Hessel *et al.*, 2008)

Transponder

A transponder is defined as a wireless communication device that receives and responds to a signal (http://whatis.techtarget.com/definitio n/0, sid9 gci213219, 00.html).Transponder is implanted inside the body. Transponder is having silicon chip and an antenna. Silicon chip having 12digits for identification of animal and 3 digits, for country code. There are two types of transponders, which correlate to the two major types of RFID tags.

- Passive transponders and RFID tags have no energy source of their own, relying on the energy given off by the reader for the power to respond. Cheaper, passive RFID tags are the most likely to be used for consumer goods.
- An active transponder or tag has an internal power source, which it uses to generate a signal in response to a reader. Active transponders are more expensive than passive ones. They can communicate over miles like ordinary radio communications. They are commonly used in navigation system for commercial and private aircraft.

There are many uses of this technology around us today, although they are often invisible to users. When a transponder enters a reading zone, its data is captured by a reader and can be transferred through standard interfaces to a host computer, printer, or programmable logic controller for storage or action(Mandeep *et al.*,2011).There are various types of transponders;

Ear tags

The ear tag transponder *is* one inch in diameter and can be embodied in plastic (Sherwin, 1990; Stark *et al*., 1998). In addition to the button tags there is a visual tag. However read write technology is also available. Information stored is strictly accordance with the ISO standards.

Bolus

The bolus transponders are covered by a capsule of biomedical glass and injected under the skin (Gruys l., 1993; Lambooij *et al*., 1995)can be introduce orally into the fore stomach of ruminants (Fallon and Rogers, 1996; Hasker and Bassinet weighted, 1996; Caja *et al*., 1999) using a balling gun. Bolus is irretrievable until the time of slaughter. Boluses showed higher readability (99.5) than electronic tag (89.8%) (Garin *et al*.2003).

Collar

Electronic collar are similar to that of neck chain, except that have an attached tag with an electronic number that can be read by a scanner. Electronic collars are easy to use, but they can become a dangerous and can cause choking if they are not adjusted properly to the growth of the animal or if they become hooked on protrusions during grazing.

Microchips

Microchips are a form of identification that involves the implanting of an electronic chip, with a miniature radio transponder and antenna, under the skin of an animal near the neck between the shoulder blades, or near the base of the ear (Diez *et al*., 1994). Each of these devices provides the same function, reliability

and accuracy, and is intended to last for the lifetime of the cow. The chosen RFID device with tag should be attached to the animal immediately after birth (or several days thereafter) so that information on the can be utilized for farm management practices immediately.

Trans receiver/Reader/Interrogators/Scanner

The trans-receiver is defined as a device which sends electronic signals to the tag, the tag is charged and replies with the stored information. There are two basic readers

- Portable/Handheld
- Fixed reader. The handheld can be powered by rechargeable battery (Blasi *et al*, 2003).

Fixed RFID reader

Fixed RFID reader is used at a position in which a farmer wishes to utilize an animal RFID number on a regular basis. This provides a reliable and robust source of identification. This can be used in conjunction with other devices to enable a subsequent action or series of actions to be performed, or decisions to be automatically made. For example, fixed readers may be utilized for the:

- Purposes of identifying an animal as soon as it enters the milking parlor, and subsequently recording the time and date
- To record a cow's milk production (in association with milk meters)
- To identify cows required for drafting gate operations etc.
- Provides the possibility for the basis for a wide range of optional operations to be conducted within the dairy that require individual identification of cows (e.g. automatic feeding etc).

Portable RFID reader/Handheld reader

This may enable actions identification of animals in the field. Portable readers are capable of reading the RFID tag of a animal in the field and displaying the animals RFID number on a small digital screen in-built into the portable reader, and possibly providing an audible reading of the identification number e.g. the All flex Compact Reader. A portable RFID reader could be attached to a personal digital assistant (PDA), which is loaded with herd management software and the data stored on the farms central herd management software application can be copied to this PDA – effectively providing a mobile copy of the herd information. Utilizing this arrangement, the farmer can then scan a cows RFID tag with the portable RFID scanner and the identity and information pertaining to the animal can be provided on the screen of the PDA. The farmer can then use the PDA similar to how they would utilize their host desktop computer, being able to browse the animal's information and also be able to record and update animal information on-site. For example, a farmer could give animal a penicillin injection – to record this, they simply scan the RFID tag of the treated cow, then use their PDA to record the details of that injection. Such data recording and updates may be immediately reflected in the central herd management software if the portable device has a direct network link to it (e.g. wireless network). Alternatively, if a direct link to the software is not possible, the updated information could be retained in the portable device, and uploaded to the herd management database at a later time when the device can gain a direct link to the network (i.e. transfer via network cable). Either way, the farmer will be receiving the benefits of being able to easily and rapidly retrieve and view data in the field, while also enabling simple, accurate and timely data recording. Such an arrangement would also remove the duplication of effort that is currently required on both the Strong and Cochrane farms for recording information to their herd management applications- as farmers would not be required to manually record this data in the field before entering it again into the herd management software at a later time.

Herdsman Software

It consists of laptop and computer which work as data accumulator. It contains the software that allows communication with the readers. This is required for the communication with data accumulator, where software is necessary. Herd management software provides mechanisms for farmers to store individual cow data into a database. Data can be entered into this software application manually via an easy to use, standardized interface, or alternatively, data can be automatically entered through the use of other digital devices (such as milk meters, cow weight scales) linked to this database. Such herd management software also provides RFID devices with the information required to make a decision or conduct an action.

Digital device network -wireless/wired/hybrid:

A digital device network is required so as to enable the communication of devices between one another that is RFID readers and the central herd management software. There are essentially three methods of establishing such a network - wired, wireless or hybrid. Each has their own advantages and disadvantages. The selection of the implementation type will depend upon the characteristics and preferences of individual dairy farms (Trevarthen and Michael, 2008). Now a day's formers are utilizing wireless networks. This will enable an array of devices, to be linked directly to real-time data in the herd management database. Various devices include the mainstream computer network devices, such as PDAs (Personal Digital Assistants), laptops, desktop, personal computers and printers, also provide the vital links to dairy farm devices, such as RFID readers, milking controller units, feed management units, drafting gates etc. A hybrid network involves some components of the network utilizing direct wired connections to the herd management software and server application, while other devices are provided with portable abilities. This may be the preferred option where there are devices that are intended to be permanently placed in a position, while other devices require portability. Utilizing the hybrid approach, portable devices can be connected to the network and subsequently the central herd management database at regular intervals (e.g. daily), where they can download the latest information from the central herd management database. The farmer can then remove these devices from the network, and take this device with them out into the field, where they can use this device to view, record updates or modify existing data. However, any changes made will only be reflected in their local portable version of the database at the time of recording. The farmer can then remove these devices from the network, and take this device with them out into the field, where they can use this device to view, record updates or modify existing data. However, any changes made will only be reflected in their local portable version of the database at the time of recording. The farmer must then return to base, and attach the device to the central network again to upload the data they recorded while in the field onto the wired central herd management database (synchronizing data between the two). The decision of using wireless, wired or hybrid networks must be based on the requirements and a cost-benefit analysis. It is believed that as wireless technologies advance in the future, providing greater capability and functionality while reducing costs, and will become the predominant network type. The network established by the Cochrane's to link their RFID readers to their dairy software (and herd management software), feed dispensers and drafting gates provide a strong example of the use and value that such networks can provide. While this network is currently completely wired, it could also be easily adaptable to support mobile devices (such as PDAs) in a hybrid arrangement, to enable an even greater range of abilities in the future (Trevarthen and Michael, 2007).

Radio Frequency Identification

As a birth, RFID technology has entered to the scientific world in order to be used to ascertain the friendly and enemy aircrafts in World War II (Landt, 2005).Today, RFID technology can be used in the recognition of all kind objects from a distance without contacting in various areas and it is irreplaceable for identification and tracking systems. While it's widely used in the products and inventory tracking, it is also used for monitoring and identification of animals. Because GPS systems have some difficulties indoors and hided areas (Bekkali *et al*.,2007).RFID system become forefront in identification and tracking of animal (Lui *et al*.,2007, Fadrid *et al*.,2013,Gu *et al*.,2009). Radio frequency identification technology is a form of automated data collection system that wirelessly captures and analyzes data of persons or inanimate objects using radio waves, devoted to automatic data collection and subsequent storage in a microprocessor-controlled device, such as a computer (Ruby, 2007). Sima and Ahmed (2013), reported that RFID is a technology that uses radio wave to transfer data from an electronic tag, called RFID tag attached to an object, through a reader for the purpose of identifying and tracking an object. It enables data to be collected on time, immediate to be used for emergency. It utilizes microchips which act as transponders (transmitters/receivers) that always listen for radio signals from transceivers (readers) and respond by transmitting embedded information (Granneman,2003). Information can be of various forms but the most common method for identification is a series of numbers that are unique to a person or object. RFID is one of the technologies (barcode, smart cards

,biometrics, magnetic strips) refer to as Automatic Identification and Data Capture (AIDC) devoted to automatic data collection and subsequent storage in a microprocessor control device such as computer (http://www.bitpipe.com/tlist/AIDC.html). Although the concept is similar to barcode identification, RFID does not require line of site identification and reading can be done at a greater distances than that necessary for barcode scanning (http://www.webopedia.com/TERM/R/RFID.Html)

Radio frequency identification is a wireless system that allows device to read information contains in a wireless device or tag from a distance without any physical contact or requiring a line site between the two. It provides a method to transmit and receive data from one point to another (Ayob *et al*., 2007). A typical RFID tag consists of a microchip attached to a radio antenna mounted on a substrate. The chip can store as much as possible two kilobyte of data. A microchip is an identifying integrated circuit placed under the skin of an animal. The chip, about the size of a large grain of rice, uses passive RFID technology and it is known as PIT (passive integrated transponder). Externally attached microchips such as RFID ear tags are commonly used for identification of farm animals and ranch animals other than horses. Some external microchips can be read with the same scanner used for implanted chips. The importance of RFID cannot be over emphasized, it include reduction in data entry errors, increased efficiency in the capture of data an instant ability to generate management report (John *et al*., 2005).

Application of RFID Systems

RFID providing accurate information on real time and has the control and safety elements. It has become a very important factor that brought new dimension to data storage and retrieval for management. RFID, has the ability to provide remote management and control in many areas such as defense industry, food industry, logistics and automotive. The Use of RFID is so many and is increasing every day. Outstanding applications of RFID to mention but few are, container tracking in the shipping field, tracking of products in the production line, monitoring patients, doctors and drugs in hospitals, vehicle tracking on motorways, precise tracking of ammunition in the military field, preventing products theft and unauthorized use (such as vehicle locking system), input and output controls in all areas, animal identification and tracking, baggage tracking at airports, monitoring and safety in library books, monitoring and security documents in archives (kuru, 2010).

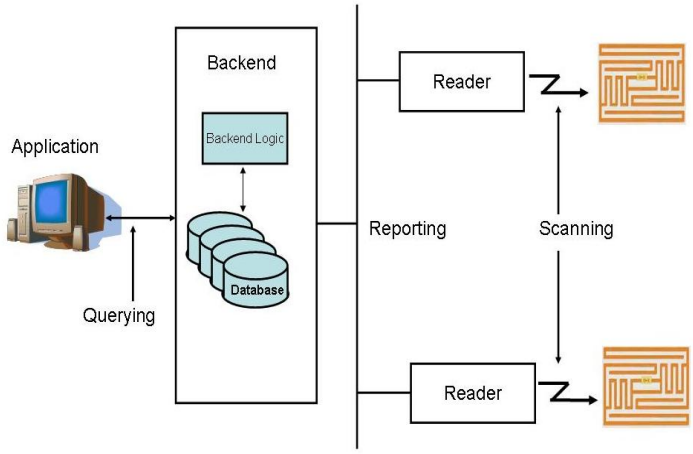

Fig1. An *RFID system (Christoph, 2013)*

How the RFID System works

The most RFID system consists of tags that are attached to the objects to be identified. Each tag has it own read only or rewrite internal memory depending on the type of application. A typical configuration of this memory is to store product information, such as an object unique ID manufactured date, etc. The RFID reader generates magnetic fields that enable the RFID system to locate objects (via the tags) that are within its range. The high frequency electromagnetic energy and query signal the generated by the reader triggers the tag to reply the query; the query frequency could be 50 times per second. As a result of communication between the main components of the system i.e. tags and reader are established (Sima and Ahmad, 2013).

Radio Frequency Identification in Livestock

Trends in globalization and incorporation of more technological advances in the animal industry have complicated the otherwise simpler issue on animal production and management. As animal food producers are finding ways to increase production to meet increasing market demands, they are also challenged by the difficulty in monitoring individual animals or herds to apply selection for genetic improvement. One of the pervasive shifts for adoption is the application of RFID technology. As the global attraction to RFID -based systems is primarily related to inventory management, the animal industry can benefit largely from the data management capability and flexibility of this system (Ruby, 2007).

RFID systems have been used in agriculture for a long time. These areas are animal traceability, farm management etc. RFID applications in animal identification and tracking systems have begun 1970s (Eradus and Jansen, 1999). With improvement and miniaturizations in electronic component in the 1980s, it has become possible producing smaller RFID tags. The first RFID tags used in animals were secured with a neck collar (Rossing, 1999). Later, ear tags and leg bands were seen. Implantable and bolus type tags followed this generation (Castro *et al*., 2010). Rumen bolus and ear tag technologies have been used commonly today. When compared to the traditional manual methods of data collection, retrieval and usage, RFID base systems have many advantages. These advantages are, storing more data about animals, monitoring animals from birth until slaughter by unique labels, tracking animal disease and easy to determine their origin, recording the transportation of animals, opportunity to follow animals without distressing them, allowing quick an multiple data readings, no need to be within line of sight of the RFID reader, improving the confidence of consumers. (Voulodimos, 2010, Stankovski *et al*., 2012 and Ting, 2007).

Radio Frequency Identification in Animal Breeding

Livestock productivity and profitability is reduced by animals which do not conceive early each breeding season. Conception at every breeding season depends on heat detection, effective serving and fertility. Inability to detect heat period, unsuccessful serving is affected by the breeding design. Fertile females may elongate their conception rate or calving interval if successive heat period are missed. It is therefore important to have a technology that may detect heat period. In every breeding herd, it is important to maximize the breeding cycle. Females may not conceive or be made non productive if their oestrus cycle and fertile bull are not availability for effective servicing. This can leave a female unproductive for longer time than normal period (Reiners *et al*., 2009). Methods designed to monitor conception in a breeding herds include a physical examination of female animal, often called the "Palpation" method. The veterinary surgeon checks for swelling of the uterus and ovary. This can be time consuming and costly task for both farmer and veterinary depending on the size of the herd being examined. Other farmers may be incapable to employ this method. Analysis of blood samples for progesterone can also be used to determine whether animals have conceived, this can also be time consuming and expensive. Gay*et al. (*2008) reported that actions to increase the conception rate in a herd involve exposing the animals on heat to servicing which may provides more conception opportunities for all female animals. A common practice to provide more conception opportunities in a herd, a farmer may either reduce the roaming distance or increase the male to female ratio of the herd for natural mating. These increases heat detection and servicing when the female is in heat, thereby increasing conception rate (Gay *et al*., 2008).Identifying when a female animal is in heat period enable a farmer to bring the female animal to a male for natural breeding or artificial insemination (AI)(Reiners *et al*., 2009). Artificial insemination is traditionally used to guarantee conception rate. However AI is still not totally effective with an approximate 50% conception rate in most cases. Also for the majority of farms, this approach is limited or impracticable due to lack of skills and facilities. Methods for determining when an animal is in heat are very important. Observation of the animals for signs of heat: mounting of the animal by other animals, swelling or reddening of the vulva, mucus discharge, restlessness or aggressive behavior, shortened feeding time and use of markers commonly employed traditionally for heat detection are faced with numerous challenges. The effectiveness of these methods dependent on many factors. The mount detecting devices which are pressure sensitive devices glued to the back or rear of the female

animal, when the animal is mounted by another, the device changes colour or provides some other indication of the mounting which can then be observed by the farmer. This requires the use of a dummy bull(s) depending on herd size and may increase management cost. All of these methods depend on personnel efficiency as such other heat period may be missed. In farms where artificial insemination is used, heat detection is an important tool for breeding. In attempting to reduce the cost by avoiding dummy bulls to use few fertile males in the herd, tracking of the parentage of the offspring can be difficult if not impossible. The use of RFID system which enables a more reliable monitoring of the oestrus cycles and breeding activities of livestock herd will be a welcome development (Reiners *et al.*, 2009).

Efficient monitoring of the breeding activities of the herd as may be provided by RFID enable the farmer to identify unproductive breeders to cull from the herd, or to take action that will rectify problems that affect the conception rate in the herd. If the herd management system had stored data, or has access to historical data of the herd and also has formation on the breeding cycle data, the herd management system can with the support of the current pedigree information be informed decisively on the way forward. All methods employed for heat detection and mating had no automotive recording of data and as such vital information are often missed. Radio frequency identification (RFID) can be employed as a system for livestock breeding and management in a herd where each female animal carries radio frequency identification (RFID) tag. This system is gaining concern globally. RFID can detects when the male animal mounts a female, based on the body position of the male animal, read identification data from the RFID tag carried by the mounted female animal generates breeding activity data including the identification data of the mounted female animal, the timing data for each mount for output to the herd management system. The herd management system is adapted to process breeding activity data output from the one or more breeding activity monitors to generate herd management data (Reiners *et al.*, 2009). The processing of the breeding activity data provides herd management data comprising conception data for each female, indicating the conception rate (Gay *et al.*, 2008). The conception data for each female is based on analysis of the mounting activity for the female animal and oestrus cycle data for the female animal. These include date of birth for each pregnant female animal, effective service or successful rate data for each male animal, fertility and ease of impregnation data for each female animal and offspring family data (Gay *et al.*, 2008). Breeding activities monitors are individually provided with a wireless communication interface whereby the breeding activity data is transmitted to the herd management system for processing. A wireless base station(s) located in the area where the herd graze to ensure that breeding activity monitor is within transmission range of the base station. Breeding activity data will be transmitted wirelessly to the base station for subsequent transmission to the herd management system. The method will allow each base station stores breeding activity data for subsequent downloading for use by farmer. A base station transmits the breeding activity data to the herd management system via a communication network. The breeding activity monitor adapted to be carried by an animal include: a radio frequency identification (RFID) tag reader for reading identification data from an RFID tag secured to another animal in the herd; a mount detector to determine when the animal mount another animal base on the body position of the animal; a processor for processing the data from the RFID tag reader, processing data system from the mount detector to generate breeding activity data to includes the identification data of the mounted animals and timing data for each breeding activity (Gay *et al.*, 2008). Mount detector determines whether the animal carrying the monitor is mounting another animal based on the body angle and motion of the animal. The determination of mounts is influenced by the proximity of the RFID tag reader to the RFID tag on the mounted animal.

Low Radio Frequency identification (LFRID) in Animal Management

According to Suzanne (2015), Tagging livestock with RFID can be an important tool in a farmer's plan to identify each animal along with its pedigree and medical information. An LF reader or wand scans the animal during veterinary visits or inventory counts, and with the help of software, uploads significant information on each animal to a database. These new livestock tracking RFID systems use UHF RFID and GPS to track the animal's movement in order to identify feeding and travel habits, and even monitor heart rate. Livestock animals are not

the only animals currently tracked using RFID. Veterinarians are now pushing for all household animals to be tracked using RFID in order to create a system to identify lost and found pets. If all household animals are tagged with LF RFID chips, when they are found, vets can scan their tag to see information such as identification and the owner's contact information. RFID chips that identify all pets on a nation-wide database can help reunite lost pets with their owners. Tagging animals using RFID is to manage exotic and endangered animals on preserves or other wildlife habitats. LF RFID, UHF RFID, and GPS systems are all used in animal management. The specific system selected is usually dependent on the information needed and safety of the animals.

RFID for Animal Identification in Rural India and Asia Pacific

In Indian, in the 18th century RFID tags were used by most cattle farmers to maintain database and collection of data and storing of information of each and every animal with its breeding, feeding and yield data .Milking and egg laying database and monitoring can easily be recorded and maintained, enabling improvement. The usage of RFID tagging helped to improve agro management through increased efficiencies, controlled monitored feed as well as reduced feed cost and labour, enhanced outcomes and exponentially improved group health. RFID usage helps livestock owners to update records of all animals at birth, death, castration, movements, pregnancy, insemination, accident and other information with dates. By collecting secure, authentic and real time data, the farmer can get correct statistical analysis and on time information which helps in decision making. It will also helps to provide properly and timely treatment of cattle health related cases ,history and improving management, sales of breeding animals and genetic improvement. Furthermore RFID tags are very accurate, precise, and faster and can be easily implanted, also (inside) attached (outside) of the animal without any harm. (Shashikant, 2017).

Radio Frequency Identification for Sheep Management

According to Jacintha and Zoe, (2013), RFID technology can be used as a means of tracking animals' property, through sale yards, feedlots and abattoirs to provide traceability. It may also be used on farm to collect individual performance data such as weaning weight, fleece yield and quality or used in conjunction with automated drafting system. It also improves time efficiency and reduces labour cost when working with large numbers of livestock recording and analyzing large amount of data .Contractors be can employed to scan electronically tagged sheep. Using their own RFID reading equipment, which they temporarily set on farm .They are able to scan a large number of sheep per day and to manage scanned data, transferring data to their personal contact or phone in an easy to read format. For example, ewes identified as potential culls can have their identification number loaded into your RFID stick reader, so when the ewes are scanned again the reader will tell you which ewes you have identified as needing to be culled. RFID tags provide ability to record sheep movement when required, genetics, breeding history and nutrition. RFID allows the producer to electronically document the RFID number of each animal (sheep). It is a valuable tool for recording animals' stock numbers and movement.

Identification and Validation of a Radio Frequency Identification System and Automatic Sorting Technology (AST) for Real Time Correlation of Management and Diseases Impacts on The Performance of Swine in Fields Study

Report by Ruby (2007), shows that RFID was paired with automatic sorting technology (AST) which utilizes electronic scales for automatic weight recording and sorting of pigs as they pass through. Pigs in barns were tagged a day after their arrival were pigs weight, scale visits, and duration of tags transmission were monitored up to the first day of market.

Use of RFID Tags Auto Sort Scale in Monitoring Growth of Pre-Infected Finishing Pigs

To monitor the effect of Porcine Reproductive and Respiratory Syndrome (PRRS) virus infection on the growth of finishing pigs under field condition, a cohort study was carried out on finishers raised in commercial finishing barn in central Iowa equipped with electronic scale that automatically sort pigs and whose functionality was enhanced by an integrated radio frequency identification system9RFID). This technology has been use in swine farms to reduce sort loss, promote early market of heavy pigs, and labor saving and improved animal

welfare, (Morrison and Vansickle, 2004 as cited in Ruby *etal*., 2007).

Use of RFID System on Animal Monitoring

According to Habib *et al*. (2016), mad cow disease, bird flu, tuberculosis and brucellosis are common diseases seen in animals. These diseases have increased interest to the health of food production and animal husbandry (Marchant, 2002). This increased interest, in many countries, has led to take strict precautions to identification and tracking of animals. With these precautions what is aimed is to prevent the spread of diseases to other locations and to identify quickly the origin of diseases (Chang *et al.*, 2010). United States Department of Agriculture (USDA), in USA, after the occurrence of mad cow disease published a plan. This plan includes the identification animal by RFID tags. Also it has put different databases that include information of animals. Monitoring of the record deliveries and disease control can be considered as the purpose of these systems (Grubb, 2010). European Parliament Regulation No: 1760/200, establish a system labeling of beef and their products and identification of animals. This system includes "cattle passport" and national computerized database (European Commission, 2009). With the same regulations by keeping records of animals using RFID tags and include that recording meat and meat products database have been emphasized. Australia, Canada, Japan and many other developed countries, have established RFID-based systems for monitoring and identification of animals and animal products. These countries have also begun to implement strict follow- up policies (Feng *et al.*, 2013). RFID technology is not limited only to identification of animals, especially using the advantages adding sensors to the active tags.

Application of RFID in Diary Herd Management

Akhilesh *et al*., (2013) has reported that for efficient management of large herd operational RFID can be a tool for the dairy farmer through which the farmer can obtain the profitable milk production by automatic weighting, automatic milking, reproduction management and health monitoring. It can be very good tool for the insurance and tracking animal in the field. RFID technology is quick, easy and accurate. It is difficult to replicate /counterfeit. It is more efficient management, time and labour saving. It is dynamically data storage and data can easily view, analyze, manipulate & sort.

Using RFID for Diary Cattle Management

Dan,2006 reported that RFID electronic identification was use for collection of dairy cattle information including: heifer body weights, milk weights on test- day, reproduction and veterinary checks, health data and group movement. Animals were tagged with ear tags containing the RFID chip. Cows are identified in the chute or lockup stanchions by waving a wand near the ear, which transmits to a hand-held computer (Palm PDA). Using the newly developed Pocket Dairy for RFID program associated with PCDART from Dairy Records Management Systems, management data can be entered and automatically attached to the cow's data file. This electronic identification can reduce labor required for record keeping and improve accuracy of records. RFID tags can be read by use of a portable wand connected by cable to a laptop or other portable computer. Alternately, a special kind of wireless communication called "Blue Tooth" can be used to transfer the RFID from the wand to a Palm or other handheld computer. Another method of reading the RFID utilizes a stationary panel reader.

We installed 100 tags of each of the following types: Allflex half duplex (HD), YTex full duplex (FD) and Temple FD. These were placed in the left ear of Holstein heifers between 3 and 12 months of age. Each of these tag types was easy to apply and had similar retention. After 18 months only one of the 300 tags has been lost. After the initial tagging of young animals, we have tagged all animals at the University of Florida, Dairy Research Unit including 527 adult milking cows, 354 heifers and 47 bulls. At two other cooperator herds, 390 cows and 268 heifers have been tagged. Readability of tags has been variable. Our standard procedure was to apply the tag then read it with the AgIofolink wand, immediately. All of the tags except one, read successfully, immediately after tagging. We attempted to read the tags again approximately two weeks after tagging.

Use of Radio Frequency Identification to Monitor Dairy Cows

Steven *et al*., (2012) reported that dairy cows and monitoring of small cattle farms are usually based on utilization of barcode technology. RFID technology is a better solution in this case. This paper describes the research and

implementation of the milking cycle's automated monitoring with the use of RFID tags conducted on small scale cattle farm in the Republic of Serbia. This solution is based on RFID system which consists of two parts. First part includes control box, two ultra-high frequency (UHF) RFID readers operating at frequency of 915MHz and RFID tags glued onto the diary cow ear labels. Second part includes software modules for acquisition and collecting of data from RFID tags to build up an archive due to supervision and analysis of the milking cycle. Reading accuracy of RFID system in the period was observed period was 99.8% in average. A group of diary cow having a settled milking cycle within an interval of 12h±5% had a 1.5% better yield and a 0.08 better quality in comparison with a group of diary cows having a milking cycle variance higher than 20%. RFID system implemented in described way can easily be integrated into a new or existing farm management system in order to have a better production result which depends on several factors including settled milking cycles.

Use of RFID System for Automatic information on Milk Records

Milk is the primary product for the farmer and it is important to know how much milk each cow is producing and likewise, to have a source of feedback to establish what factors enable your cows to produce the maximum amount of milk. Milk meters provide this valuable ability, measuring the amount of milk each cow provides at every milking session. In this method milking of cows is carried by machine milking which is connected to sampler in which the milk drawn from cow is filled by machine, the sampler is connected to milk analyzer which finally passes all the information to computer which includes electrical conductivity, temperature, chemical composition, colour, SCC (somatic cell count) and particle size. When a cow enters the walk way entrance of the milking parlor, the computer screen at the parlor displays such information as unique cow's number, last milk yield, somatic cell count, and disease with medicinal treatment information for milking workers to pay attention (James, 2004). It is believed that the implementation of these devices could become an integral component of dairy farming in the future. As previously alluded to, a great benefit that milk meters provide is the ability for farmers to achieve a complete cycle of information. Currently, farmers are able to control and measure many aspects of a cow's environment and lifestyle. However, without milk meters, farmers are unable to accurately gauge how varying certain elements in a cow's environment may affect their milk production.

Use of RFID System for control of milking controller unit

Milking controller units are essential equipment for all modern dairy operations. This is the device that controls the suction and suckling motion of the milking cups attached to the teats of each cow. It is recommended that RFID technology, combined with herd management software be incorporated in all future implementations of milking controller units. Combining these technologies will provide a range of enhanced options and capabilities for the operation of the milking controller unit**.**

Use of RFID System for Monitoring Feeding Behavior in Beef Cattle

Mendes *et al. (*2014) revealed that RFID based system (Grow safe System Ltd. Airdrie, Alberta, and Canada) was used to measure feeding behavior traits in beef cattle fed a high grain diet. Feeding behavior data were recorded by the Grow safe system and time-lapse video using 10 heifers over a 6-d period. Observed bunk visit (BV) and meal event data (frequency and duration) were compared with electronic feeding behavior data generated by the Grow safe system at 5 parameter settings (MPS; 30, 60, 100, 150 and 300s), which are used to define the maximum duration between consecutive electronic identification recordings to initiate a subsequent BV event. A random coefficient model was use to compare video and electronic data using orthogonal contrasts. Video data were regressed on the electronic feeding behavior data to obtain an estimate of precision (r^2) and other statistical estimates, including mean square error of predictions. The variation in MPS values affected the BV data, but not meal event data. Electronic meal frequency and duration data were not different ($p>0.50$) from observed values, and were not affected by electronic MPS values. The optimal MPS value for prediction of BV and meal event frequency and duration traits was 100s. Our evaluation indicated the Grow safe system 4000E was able to predict BV and meal event data when the 100-MPS event data was used to analyze the feeding behavior data.

Use of RFID System for Automatic Weighing of Farm Animals

The weight of cows is another significant factor that can be used to determine the overall health of a cow. The weighing scale may be placed at the entrance in the shed of the dairy, which is associated with a permanent RFID reader, enabling each animal to be identified before standing on the scales and their resulting weight to be recorded in the herd management database. The weighing balance is associated with load bars present on the base of weighing balance, which is connected to fixed scanner either by wireless network or through wires; the scanner information comes on display, which is finally stored in computer. Alternately, mobile readers can be used

Monitoring Behavior of Poultry Based On RFID Network

Report by Zheng *et al*., (2016), says that chicken from Jianggao Town of Guangzhou was chosen as the research site and the free-range chickens as the research object. By monitoring the behavior characteristics of chickens, this project established the disease warning system and automatic classification assistant system. In this farm, the chickens are classified feeding according to their quality. In order to make the results more reliable, the first class fence with 13 chickens was taken as the experiment point. And 5 sick chickens from the third class fence and 6 normal chickens from the second class fence were added into the experiment point. According to the standard of farm classification, chickens in the first class fence have strong activity and proper weight (about 1.5 kg). And chickens in the second class fence have less activity and higher or lower weight. And chickens in the third class fence have the worst activity. In this system, the RFID collectors were used to collect data. By calculating characteristics such as the order of arriving to feeding site, the resting time and speed, chicken's activity can be identified. The activities of chickens such as eating in the feeding site and moving around between several fixed resting sites were recorded in this system by placing RFID-tag-collectors in these sites. In the research, each chicken wore the foot ring with RFID-tag (the tag code of the foot ring represents the ID of chicken), and RFID-tag-collectors were placed in those fixed resting sites and entrances of the feeding site for continuously gathering the ID of chickens with the frequency of 3 times per second (the collectors also recorded acquisition time). Then the data from collectors were uploaded immediately by wireless transmission nodes.

Whose information can be sent in computer by means of blue tooth software present in mobile reader. Later, this data can be viewed and analyzed by the dairy farmer. E.g. animal may lose weight when she is not given (or is not eating) enough food to satisfy her energy requirements to continue producing high quantities of milk. However, a loss of body weight may also occur if a cow falls sick, feed intake is restricted etc.

Use of RFID System for Health and Reproduction monitoring

RFID helps in health monitoring like monitoring health of herd (physiological parameters, mastitis) and individual medication and vaccination records. Sick animal identified at early stage and segregated for treatment (Eradus and Jansen, 2009).

Use of RFID System for Temperature monitoring

RFID microchips can read the temperature of the cow along with the cow's unique identification number (Higgins, 2003; Hostettor, 2003). Wireless Temperature Sensor is embedded in specially-designed rumen bolus and requires no batteries. It resides permanently inside the cow and automatically measures a cow's core temperature providing advance alerts of critical changes in temperatures which may allow early detection of sickness, estrus, heat stress, and the onset of calving (parturition). A rise in temperature may also indicate that the animal is in estrous period and also activity of animal will be increase up to 30%to400%. Activity is measured by ankle pedometer or activity meter. This will provide opportunity to the farmer to artificially inseminate the cow (Smith and Saunders, 2005).

Challenges to the use of radio frequency identification of animals

A system as vast as radio frequency identification (RFID) of farm animals could be extremely expensive. There is a school of thought that the costs of applying RFID for animal identification will drive small farmers out of business, due to the cost associated with registering each animal.

Small farmers and families that sell off parts of their herds or flocks every year would have to register and pay a registration fee for every head of livestock or poultry. While this is true, corporate livestock breeders and organization may adopt this technology to accumulate quality records, select and breed appropriate foundation stocks for the small holder's farmers. This technology is easily adopted by corporate farms with large herd or flocks that move through the production chain as a group, as they will have to pay fee equivalent of owning one animal (Bowling *et al.*, 2008). Small farmers and families may not adopt in totality the RFID technology, but focus on animal identification to minimize theft as a tracing device. Tracking of livestock, and poultry, in its broadest context could or will eventually be used (1) to determine origin and ownership, and to deter theft and misrepresentation of animals and meat; (2) for surveillance, control and eradication of exotic animal diseases; (3) for bio-security protection of the national livestock population; (4) for compliance with the requirements of international customers; (5) for compliance with country-of-origin labeling requirements; (6) for improvement of supply-side management, distribution/delivery systems and inventory controls; (7) to facilitate value-based marketing; (8) to facilitate value-added marketing; (9) to isolate the source and extent of quality-control and food-safety problems; and (10) to minimize product recalls and make crisis management protocols more effective.

The costs of becoming NAIS compliant for a U.S. beef producer were found to be a minimum of $2.08 a head for large producers and as much as $17.56 a head for smaller operations, with an estimated average cost to cow/calf producers of $6.26 per animal. A spreadsheet developed to calculate the costs of an RFID-based animal identification system (Bowling *et al.*, 2008) puts the costs at $7.21 per head for a herd of 250 cattle, based on variables including the cost of tags and hardware such as readers and computers. Management and breeding of animals is becoming increasingly challenging and important to producers. In European Union (EU), tracking is driven mainly by food safety concerns while in the United States of America it is perceived as important with regards to bioterrorism and food safety. In Africa, only Botswana and Namibia has adopted animal identification using RFID and it is mostly for traceability. Electronic identification (e-ID) using radio frequency (RFID) passive transponders improves quality of data and breeding due to accurate monitoring of livestock performance, easier management of databases and data processing for inventory and movements between premises.

Potentials of the use of RFID for genetic improvement and management of indegenous livestock breeds in Developing Countries

The cost of applying RFID system in breeding and management of indigenous livestock breeds appears high for individual rural farmers. Its advantages however far outweigh the cost. The challenges of genetic improvement of indigenous livestock in developing Courtiers are lack of records of performance, small herd sizes, inability of the rural farmers to collect records due to illiteracy, inability and lack of capacity of livestock improvement institutions to keep large population sizes to which effective selection can be apply and counter selection (removal of best animals) of animals for use or sale due to higher values. All indigenous livestock ecotypes in developing countries are highly adapted to their production systems and environmental challenges as they fit into the socio- economic and cultural values of the rural dwellers.

The only alternative breeding strategy that may be effective in developing countries for genetic improvement of local breeds on free range under rural farmers is to introduce cooperative breeding scheme. This involves the organization of individual herds into large common herds for effective selection. This can be achieving by the use of RFID. Rural populations can be divided into strata upon which RFID system would be applied. Potential animals identified by the RFID system can then be selected for genetic improvement in desired traits.

Government and Non-gornmental organizations can fund the cost of applying RFID system targeting the most valuable local breeds. Records of performance, effects of management systems as well as the effects of global climate change impact on the co adapted gene complexes, new diseases prevalence and mobidity can become available for use. This may not only provide tools for effective selection for genetic improvement, but may also assist in detecting population states, levels of treats and continued use of the local breeds and eventual conservation of these breeds for future use.

CONCLUSION

FRID system can be applied to all aspects of animal production for efficient record keeping. The advantages of the use of RFID system of data generation, provision of selection tools and other management tools will eliminate the challenges of inadequacy of production records. These will facilitate genetic development of the indigenous livestock animals in developing countries. Government and non-governmental organizations can fund the cost of applying RFID system targeting the most valuable local breeds. Rural livestock herds under individual farmer should be organize to form large cooperative breeding herds upon which the RFID system can be applied for data generation. Corporate livestock organizations may also adopt RFID system to enhance quality recording and monitoring of data in developing countries. These can be used for selection and breeding to produce improved foundation stock for smallholder farmers.

RECOMMENDATION

The time has come for leadership, Non-governmental organization, wealthy individuals, Politicians Philanthropists and cooperate bodies in the developing countries to collectively fund RFID systems application to livestock production. This will generate data for the genetic development, management, effective utilization and conservation of indigenous breeds in their respective countries. Government and Non-gornmental organizations must rise to their responsibility of service and provides funding for RFID systems for introduction into animal breeding and management in developing countries.

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