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THE USE OF DEOXYRIBONUCLEIC ACID IN COMBATING STOCK THEFT: EXPERIENCES AND RECOMMENDATIONS OF SOUTH AFRICAN POLICE SERVICE KWAZULU-NATAL SELECTED STOCK THEFT UNITS

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─Abstract ─

Existing literature propagates a variety of methods in combating stock theft across South Africa and elsewhere. However, Deoxyribonucleic Acid (DNA) technology has been designed to revolutionise modern science and to enhance conventional methods of combating stock theft. The paper examines the experiences of three members of Stock Theft Units (STUs) of the South African Police Service (SAPS) in KwaZulu-Natal (KZN) Province, as these experiences relate to the use of DNA technology to verify identity and ownership and link criminals to crime scenes in the event of livestock being stolen, illegally relocated and slaughtered. The researchers found that the selected STU members are knowledgeable about this application, entirely focusing on the chain of custody in terms of handling of the exhibits from the crime scene to respective laboratories. Based on the findings, a new South African DNA technology conceptual framework for combating stock theft was developed, combining the available technologies with conventional methods to enhance the turnaround time analysing the DNA results.

Key Words: *Combating, Crime scene, Deoxyribonucleic Acid technology*

JEL Classification: Q55

1. INTRODUCTION

DNA is the abbreviation for deoxyribonucleic acid, a chemical which is found in virtually every cell in the human body and in animals, carrying genetic information from one generation to the next. Just like fingerprints, each human has a unique DNA signature that remains unchanged throughout his or her life, and animals are no different. Fingerprints can only be found at a crime scene if a person touches a suitable surface with bare fingers, but DNA can be extracted from hairs, skin cells, blood, fragments of bone, or teeth, as well as body fluids left at a crime scene.

DNA testing, generally called DNA profiling, takes advantage of the fact that, with the exception of identical twins, the genetic material of each person is unique and is an omnipresent residue that trails people wherever they go. The integration of DNA technology and DNA profiling is paying dividends within the Criminal Justice System (CJS).

The CJS is reaping the rewards of the integration of DNA technology and DNA profiling, with the latter being a unique set of numbers obtained from a person’s DNA that acts as a personal identity document (ID) number, animals included. In cases where traditional fingerprints are not found, DNA profiling may also link a potential suspect with a crime scene. Ongoing success in the location of evidence at crime scenes has made it a critical tool in fighting crime, and DNA technology is used worldwide to convict and exonerate potential criminals. It enables forensic scientists to re-examine cases left unresolved owing to lack of evidence and the use of DNA tests as evidence has enabled many prisoners who were originally found guilty to be proven otherwise. This technique was also indispensable in identifying bodies of victims following events such as the bombing of the World Trade Centre on 11 September 2001 and the tsunami on 26 December 2004, as well as the bodies of apartheid activists buried, alone or in mass graves, in South Africa (http://dnaproject.co.za/dna-project/dna-and-crime-resolution).

The aim of this paper is (i) to explore the perceptions of selected SAPS STUs in KZN Province regarding the use of DNA technology in combating stock theft by determining the methods and techniques used by SAPS to combat stock theft; and (ii) to identify factors that hinder effective curbing of stock theft by making use of documentary study, Focus Group Discussions (FGDs) and Key Informant Interviews (KIIS). A brief literature review is followed by a discussion of the methodology used in the study, and an analysis of the data is followed by the identified challenges and themes, recommendations and a conclusion.

1.1 Context of the study

1.1.1 Deoxyribonucleic Acid technology

Greyling (2007:41) holds the view that stock theft is one of the most important challenges faced by resource-poor farmers in South African communities and has the potential to cripple their livelihoods. On a national level, close to 700 000 animals such as cattle, sheep and goats were reported stolen in the period 2003 to 2006. Annually, the direct cost of these animals amounts to approximately R360 million, which proves costly to emerging stud farmers, especially in rural areas. For the 2014/2015 financial year, the SAPS managed livestock confiscation of a negligible 1716 sheep, 727 cattle and 166 other livestock clearly, indicating the difficulty associated with policing of this scourge. The impact of stock theft on resource-poor and small-scale farmers is often more severe due to the frequently low numbers of animals owned.

An average of 30 000 cases per year have been reported for the past five years, representing a monetary loss of R750 million annually. From 1 April 2013 to 31 March 2016, 56 954 head of cattle to the value of R592 321 600 were stolen. Of this figure, 22 070 were recovered, meaning that 34 884 head of cattle to the value of R363 793 600 were lost. As regards sheep, 79 713 were stolen at a value of R135 512 100. A total of 16 663 were recovered, resulting in the loss of 63 050 sheep which cost sheep producers R107 185 000. A total of 34 988 goats were stolen, of which 10 600 were recovered, a loss of R47 556 00.

In 1996 the SAPS and the Animal Genetic Laboratory (AGL) of the Agricultural Research Council's (ARC) Animal Production Institute (API) in Irene entered into a partnership to combat the challenge of stock theft with the aid of DNA technology. According to the SAPS, various court cases have been successfully concluded through the use of DNA. In these court cases, which include more than 3 000 pieces of evidence, results of DNA analyses have been used as evidence. Approximately 95% of cases were solved and the suspects prosecuted. DNA technology can be used as an important forensic instrument to combat stock theft and is becoming an increasingly important component of the criminal justice system. DNA-based technology is used largely for the determination of identity, ownership, percentage, traceability and the species origin of animal products such as tissue, blood and skin.

This application makes it possible to provide a means of irrefutable identification of animals as well as humans, since each individual has a unique DNA profile. For the purpose of combating stock theft, hair samples (one of the sources of

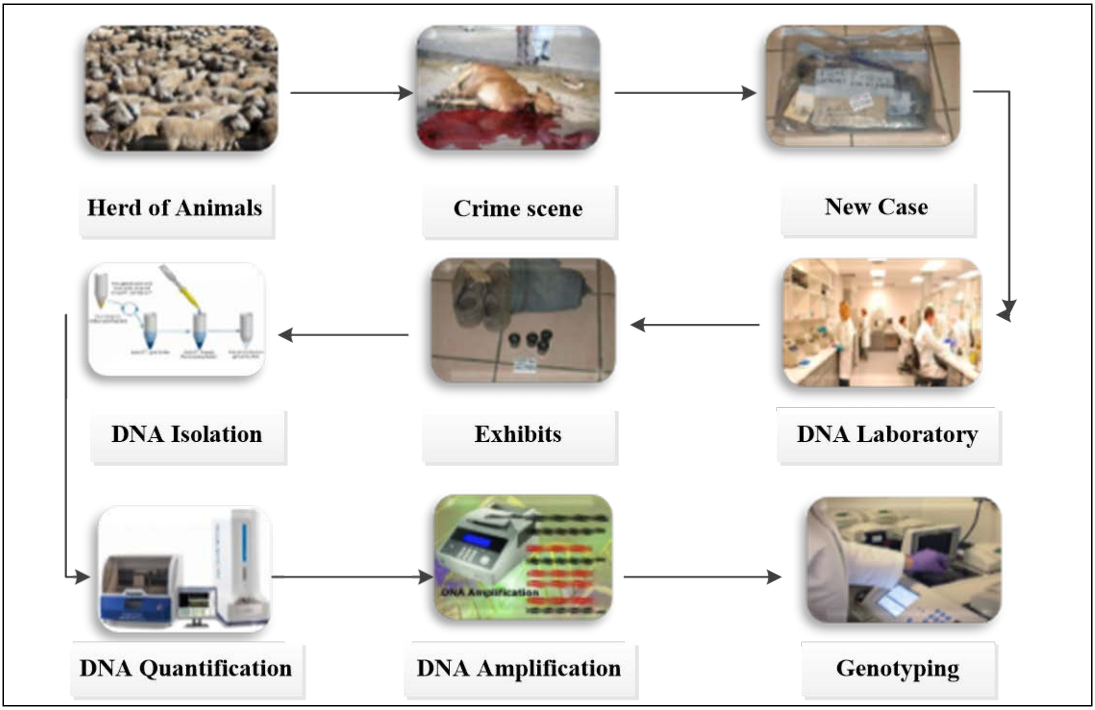
DNA) are collected from individual animals and stored in the laboratory as reference samples. When animals are injured or slaughtered at a crime scene, or a piece of meat from a stolen animal is found in the possession of a suspect, a tissue sample is taken and compared to the reference sample in the laboratory. If the DNA fingerprint of the reference sample matches the sample from the crime scene, the suspect can be connected to the crime scene or the crime itself, and evidence can be used to convict the offender. Even if the there is no reference sample available, conviction is still possible if DNA from the blood, bloodstains, meat or other tissues found at the crime scene is compared to blood found on the suspect's clothes, tools that were used or meat found in his possession. The success of the forensic DNA services is dependent on the correct collection of samples at a crime scene, processing and analysing thereof in the laboratory and reporting of the findings. To ensure that each part of the process is handled correctly, SAPS staff receives continuous training from the ARC. This training focuses on aspects such as DNA sampling, preservation, documentaries and dispatching of samples to the laboratory, National Stock Theft Prevention Forum [NSTPF] (2016:32, 34-35).

Greyling (2006:13 & 15) highlights the difficulty in determining the livestock owner as one of the biggest problems associated with the theft of animals. With reference to one of the conventional methods of animal identification, South African law stipulates that animals older than six months must be branded for identification purposes. Some livestock farmers ignore this important requirement and stock thieves often try to change the existing brands, which makes it very difficult to locate the owner. Sources of DNA such as blood, skin, meat, bones, intestines and even hair roots of animals can be used to identify an animal and link a potential suspect to a stock theft scene. DNA is similar to a fingerprint; fingerprints do not look the same and no one's DNA is the same. The DNA belonging to an animal is not something that can be seen with the naked eye, which makes it inalterable by criminals. Operationally, law enforcement agencies across the globe have been using human DNA in the courts for a long time and now it can also be used when animals are stolen.

The AGL of the ARC's API has a new product named Livestock Identification Catalogue (LIDCAT) that helps the police to catch stock thieves. A nine-digit barcode number is allocated to each sample and to the corresponding animal from which the sample was taken, and given to the owner of the animal for his/her record-keeping purposes; this is similar to having an Identity Document (ID) of each animal. The animal is also marked and ear-tagged to make visual identification easily recognisable.

In the event that an animal is stolen, illegally relocated or even slaughtered, a biological sample of such an animal can simply be taken and its DNA profile compared to that of the reference sample in order to verify its identity. The DNA “fingerprint” of the animal stays the same throughout its life, and because no one can change it and the SAPS STUs members can use it to find animals and identify even dead ones. Subsequent to this finding, DNA technology is widely used internationally and locally to solve stock theft cases (refer to Figure 2 depicting the developed conceptual framework in combating stock theft in South Africa). This application has revolutionised modern science, and as it evolves, more and more applications are discovered to help the criminal justice system fraternity understand all living organisms. DNA or the genetic material passed along from one generation to the next holds many clues that have unlocked the mysteries behind human behaviour, biological inheritance, biological identities, genetic diseases, evolution, and aging. Recent advances in DNA technology, including Polymerase Chain Reaction (PCR), cloning, DNA fingerprinting, gene therapy and genetic disease diagnosis have started to shape medicine, forensic sciences, environmental sciences, and national security, Universal Genetics (2015:1).

Figure 1: The chain of custody of forensic samples



Sources: Mapholi (2015:np) and Researchers' illustrations

Mapholi (2015:np) points out that the success of the DNA forensic service in combating stock theft relies heavily on the chain of custody of forensic samples, for example, the entire process of collecting samples starting at the crime scene and ending at the laboratory, as shown in Figure 1. To ensure adherence to the chain of custody, the ARC provides training to SAPS personnel several times per year in functions such as DNA sample collection, storage, and dispatch to the laboratory. The benefit of the training is demonstrated by the quality of DNA exhibits brought to the laboratory by SAPS. The author goes on to say that stock theft has broader implications than the loss of animals; the issue also affects food security. Through the use of DNA microsatellite marker technology, experts have managed to resolve the identity of lost or slaughtered livestock, livestock paternity in livestock ownership dispute cases and uncertainties in animal origins of meat products. Although some of the cases remain unsolved, those that are reported and investigated have led to an increase in the prosecution rate of stock thieves. To this end, DNA technology can be used as an important forensic instrument to combat stock theft and is indeed becoming an increasingly important component of the CJS.

1.1.2 Radio Frequency Identification system

Silveira (2013:26) quoting Kampers *et al.* (1999) conducted an extensive review of the literature on RFID technology and how it works; the author found that the Electronic Identification (EID), which is part of each RFID tag, is entirely unique as mandated by the International Organisation for Standardisation (ISO) 11784. This uniqueness renders it the best method of official identification. The author further found that RFID technology is ideally suited to be the United States Department of Agriculture's (USDA) only form of official identification and that the USDA's Animal and Plant Health Inspection Service (APHIS) only made these changes to the rule due to producer resistance. Currently there are many countries that require the unique identification of livestock and have implemented RFID systems to aid the efficiency of these national systems. This information led the author to conclude that some countries in the world consider a national animal identification system imperative for the maintenance of the health of the national herd in order to ensure a good market for their exports. Whenever a disease outbreak occurs it becomes the government's responsibility to investigate the outbreak and discover its source.

The software integrates data to the livestock management system and with the RFID system the detection of livestock exceeding determined boundaries is made possible, triggering a quick response to the crime scene or area of danger. Farmers have to employ different preventive measures in an attempt to protect their livestock. Moreover, they are expected to manage intricate technological advancement in the DNA technology used to combat stock theft within their respective communities. Globally, the demand for the use of DNA technology in combating stock theft is increasing. However, the number of livestock farmers are decreasing year on year. As a consequence, stock theft will continue to increase if ignored as is presently evident.

This trend is driven further by the low profit margin per domesticated livestock; the keeping of such livestock is not precisely directed to the income or profit gained from individual livestock. In other words, the size of livestock kept does not determine the viability of expected income or profit to be made, thus commercialisation remains distant. Livestock are kept to be sold when a need arises; with limited time catered to the conventional methods of combating stock theft, making it more difficult to protect animals and prevent the scourge of stock theft effectively.

1.1.3 The integration of Radio Frequency Identification, ZigBee, Wireless Sensor Nodes and Wireless-Fidelity in combating stock theft

According to Nkwari (2014:2-3), many systems have been developed for the identification and tracking of animals among farms in South Africa. However, the current animal identification and tracking systems come with certain limitations and high costs. For example, the system based on passive RFID technology shows limitations in the short communication range and mobility to automated monitoring of the animal in real time. On the other hand, the system based on GSM is expensive because, in addition to the system's price, the costs of Short Message Service (SMS) and General Packet Radio Service (GPRS) data have to be added, which increases the total expenditure. The typical design structure of a WSN consists of sensors, Central Processing Unit (CPU), transceiver and a battery. Wireless Sensor Node (WSN) architecture is constituted of main parts, namely transceiver, sensors, CPU and battery. These devices are indispensable because they are part of everyday life, for example, cameras inside cellphones.

The camera is an image sensor that converts the optical image into an electrical signal which can be treated and sent somewhere else. There is also a temperature sensor which converts the temperature in the vicinity where it is installed into a voltage (always proportional to the temperature). The following resources are required for the operation of this application:

- A **transceiver** is a device that converts the electrical signal into an electromagnetic signal and vice versa. This equipment allows transmitting the data sensed by the sensor to another transceiver which is situated far way. The transmission is performed wirelessly, meaning that there is no physical connection between the two devices;
- The **CPU** is the main device which coordinates all the other devices, such as when the node has to sense and send data and determining which data has to be sent. The CPU acquires the raw data coming from the sensor. Samples of data are taken at regular time intervals and sent to the transceiver. The transceiver sends the data to the next transceiver which may be the base station. It is assumed that the CPU has sufficient memory to perform the tasks; and

- All **electrical equipment** needs to be powered, because the node uses battery power; the use of this resource has to be optimised to prolong battery life (Nkwari, 20148-9).

A reliable WSN must be able to gather information, compute the information and then send it to the base station where the information is processed and stored. A WSN is composed of four main parts which are the CPU, the transceiver, the sensors and the power supply. The general overview of the WSN can be placed on various animals in a herd. The WSN uses both a Wi-Fi module and a ZigBee module for communication. For the research under interpretation a prototype of the node was built and tested. This early node worked on 5 volts. It was decided to run the micro controller on 3.3 volts as well, because the author's GPS and transceiver require 3.3 volts.

There was a way to establish communication between the two devices that have different power supplier voltages: The solution was to use a logic level converter from 5 volts to 3.3 volts, among others. Because cost is one of the major issues in the design of WSN, it was decided to use a micro controller that uses the same range of voltage (3.3 volts) (Nkwari, 2014:51).

Nkwari (2014:vi-vii) further mentions that cattle management is a task that requires an enormous amount of physical energy and human resources. A novel approach using a WSN system based on ZigBee and Wi-Fi is proposed and this has the potential to decrease cattle rustling and improve the quality of remote cattle management. The WSN application determines and circumscribes a safe zone where the herd has to be according to the behaviour of the animal and the herd in general. Nkwari (2014:vi) goes on to note that a WSN, based on ZigBee technology, can determine an animal's position and speed which data are then analysed to get the probability distribution function for the cattle behaviour. The cow's position is obtained and sent to a control unit for centralised monitoring.

A Continuous Time Markov Chain Process (CTMP) was used to model the behaviour of the cattle. In brief, the Markov process is the study of a random process or stochastic process. The CTMP was used because the movement pattern of a cow is random and will not occur at the same frequency (Nkwari, 2014:43). The WSN system can mitigate livestock theft and assist the farm manager by monitoring the position of cattle. This system can alert the farm manager when the cow is out of the safe zone. A heterogeneous wireless network was formed with ZigBee and Wi-Fi technology. These two technologies provide the system with the advantages of gathering the data in real-time and increase the network's coverage rage (Nkwari, 2014:vi). The current research showed how GPS data can be computed at a node, following which the speed, altitude, longitude, date and time can be sent to the sink, with the data finally stored in a base station. It was also emphasised that cattle should be in a boundary position to determine an animal's position on the field. A prototype system for cattle monitoring was designed. The results illustrated the capability, suitability and limitation of the chosen technologies (ZigBee, WSN and Wi-Fi) (Nkwari, 2014:vii).

2. DESIGN AND METHODOLOGY

2.1 Research design

The problem that informed this study was that the SAPS (SAPS STUs in KZN Province) seemed to be unfamiliar with the use of DNA technology to combat stock theft within the three selected policing areas. It is the view of the researchers' that attempting to address such a challenge requires the assessment, proper implementation and effective use of this technological application to attain the desired results. Optimal use of this application can combat stock theft incidences within the selected areas to strengthen the relationship between the SAPS STUs and other relevant stakeholders, especially the livestock farmers. In order to facilitate investigations, this study uses both exploratory and descriptive research objectives.

2.2 Research methods

The researchers adopted a qualitative research approach for this paper to grasp an imperative understanding of the complexity of the problem under investigation and to gain valuable knowledge of participants' insight and experience relating to the underlying dynamics of the use of DNA technology in combating stock theft in the selected areas in KZN Province, South Africa. McRoy (1995) as cited in De Vos, Strydom, Fouche and Delport (2005:74) further argues that the qualitative research paradigm in its broadest sense elicits participants' accounts of meaning, experience or perceptions. It further involves identifying the participants' beliefs and values that underlie the phenomena. In essence, the researchers' is concerned with understanding rather than explanation; naturalistic observation rather than controlled measurement.

2.3 Study population

The population of the study consisted of officials who form part of stock theft structures within the selected areas in KZN Province of South Africa. For the purposes of this study these structures are referred to as stakeholders. These stakeholders came from the SAPS, KZN as follows: SAPS Provincial Stock Theft Co-ordinator (1), including the SAPS STU members (14), totalling 15 participants. The selection was made to obtain pertinent answers to the research problem under investigation. The study population was confined to the three identified SAPS STUs in KZN Province (Bulwer [Pietermaritzburg], Ladysmith and Utrecht [Newcastle]).

2.4 Data collection methods

A documentary study was complemented with FGDs (12) and KIIs (3) KIIs in-depth interviews. The participants of this study were drawn from KZN Province.

2.5 Data analysis

De Vos *et al.* (2005:333) suggest that data analysis involves reducing the volume of raw information, sifting significance from trivia, identifying significant patterns, and constructing a framework for communicating the essence of what the data reveal. Researchers such as Babbie and Mouton (2011:276-278), Du Plooy-Cilliers, Davis and Bezuidenhout (2014:253-260), and Marshall and Rossman (2016:44-48) are in agreement that the traditional terms reliability, validity, objectivity and generalisability are no longer applicable in a qualitative research approach, but suitable, rather, for the quantitative approach. Therefore, the modernisation of these terms for this study rested on trustworthiness, aligning to the following four elements: (i) Credibility, (ii) Dependability, (iii) Confirmability and (iv) Transferability. The researcher enhanced the *credibility* of this study by constantly and tentatively analysing the data obtained from the participants and the relevant literature collected, as well as drawing on his own experience on the subject matter to separate relevant data from irrelevant data.

The researcher attained *dependability* standard of this study by conducting semi-structured interviews with the participants and the same questions (guided by the designed interview question) were posed to the selected different participants while addressing the aim of this study. The confidentiality of the participants was guaranteed and their interviews were conducted in privacy and their responses were recorded verbatim in their presence. This was done to ensure that when different researchers conduct the same research with the same interview schedule guide, the same findings will be obtained, in different settings, with the same people at different times, or with separate groups of similar people at the same time, among others.

For *transferability*, the researchers' advocate that the findings of this study can be applied to a similar situation, as the information that was obtained from the participants with expert views on the subject matter under investigation. As a result, thick descriptive data was gathered for this study while utilising purposive sampling method to maximise the range of specific information that can be obtained from and about the problem under investigation. The *confirmability* standard was achieved by the researcher by consulting with the selected participants and discussed the interview transcripts during the data analysis process in drafting the final research report. This eliminated any inaccuracies and maintained the objectivity of the study. The researchers' subjected this research to external audit process where it was assessed for relevance and compliance. This process further ensured objective assessment of the study and addressed the confirmability standards. Overall, the collected data were analysed to reach structured conclusions through the use of qualitative documentary analysis, data utilisation, coding and categorising processes, and the clustering of the research themes.

3. DISCUSSION OF FINDINGS

The referencing method for the interviews in this study comprised a numerical sequence. An example of this notation is as follows: (5:1:2). The first digit (5) refers to the folder number in the voice recorder. The second digit (1) is the interview number in the aforementioned folder, whilst the third digit (1) is the sequence in which the cited interview was conducted.

There are issues which emerged during the fieldwork period which the present researchers thought would be important to note in this study. The use of DNA technology in combating stock theft seems to be a new concept to participants in the selected SAPS STUs in KZN Province. Another development is that other local SAPS STUs officials are knowledgeable about the practice under investigation and noted the various difficulties associated with its use.

The data were collected around the presented themes. However, there exists an indication that an improvement needs to be made on the current stock theft combating strategies within the selected KZN areas. The study acknowledges some areas where the SAPS STUs in KZN Province performed well in combating stock theft. It was also noted that the primary analysis of data shows lack of support from SAPS management and a decline in the willingness of the livestock farmers to preserve and protect their stock, calling for undivided attention in responding to this crime.

The following themes were therefore identified during the fieldwork process and are discussed below: (i) Common usage of conventional methods to combat stock theft, (ii) Delay in obtaining DNA evidence feedback from the responsible laboratories, and (iii) Inadequate knowledge and application of the use of DNA technology.

3.1 Common usage of conventional methods to combat stock theft

It is important to understand the operation of stock thieves. The participants indicated various types of stock thieves who work as individuals or in groups. Local native residents are receivers and couriers in stock theft operations, and role players such as national buyers, facilitators and exporters make this operation very lucrative. The study found that the livestock farmers in the selected areas of KZN Province rely on the conventional methods to combat stock theft; branding, ear-marking and gum-marking received the special mention.

One of the participants had this to say:

"I do think that, although I am a very big supporter of tattooing and branding, we can use other means of animal identification and DNA technology is one of them (part one) but the world is improving and changing. There are things like microchips, bolus (Botswana and Namibia systems). In essence there are so many other means of animal identification. In all honesty, I think one of our biggest problems in the South African Constitution is that the status given to traditional leaders, they have such a big impact on the current CJS. If they do not sign off on anything, then that new law just does not get approved, like the Pounds Act (proposed National Animal Pounds Bill – Notice 398 of 2013) we have at the moment. We have struggled for the past three years to get it signed off. It gets stuck at the traditional leaders' zone; they do not want to sign off anything that is seen as a barrier to them." (KII-01:01:01)

3.2 Delay in obtaining Deoxyribonucleic Acid evidence feedback from the responsible laboratories

During the fieldwork, livestock farmers indicated a need for the establishment of a Stock Theft Forensic Laboratory (STFL) in selected areas of KZN to cover the longer distances taken to submit the DNA evidence in Cape Town, Port Elizabeth and Pretoria. They did not shy away from the fact that KZN should be prioritised in this regard. Positively; the University of Pretoria and other private companies were acknowledged as being quick in providing the required feedback to the affected parties. Some of the participants' assertions below refer to the members of SAPS STUs in KZN Province:

"To be quite honest with you we have had several problems now at ARC-Irene where I think the people who are currently analysing the DNA evidence are not up to standard. In the past we used to have success, but lately it is clear that the people doing the analysis are inadequate; we are experiencing a couple of problems (in analysing the DNA evidence) there (ARC-Irene)." (KII-5:1:1)

"The feedback from the laboratory takes long … In a criminal case it can take up to six weeks and sometimes three months, the deadline is not adhered to and this create problems with the court of law as stock theft cases get reminded, but it is good to note that they are improving now; it is a bit better but it is a big challenge for us to get the DNA reports quickly." (KII-5:1:1)

3.3 Inadequate knowledge and application of the use of Deoxyribonucleic Acid technology

In stock theft cases where there is no prima facie evidence before the STUs members initiate investigation or necessitate arrest, DNA technology can be positively used to link the potential suspects with the crime in question. The collaboration of the SAPS and the AGL of the ARC – API in Irene cannot effectively combat stock theft in the selected areas of KZN Province. The capacity and resources will always fall short. The lack of knowledge on the use of DNA technology to combat stock theft cannot be blamed solely on SAPA STUs works in KZN as they are a number of departments involved. Thus, a call for collaborative work remains of importance. Several factors such as lack of resources, inadequate training, inexperienced SAPS STUs detectives are but few of the identified obstacles in this study.

Much needed support should be directed to the livestock farmers by the government, SAPS management and other relevant stakeholders. Stock thefts have potentially serious and negative impact. There are indications of it diversifying and extending into new realms, and it is not only affecting rural emerging livestock farmers, but established individuals within the commercial farming sector as well. It is a known fact that, if it is not successfully controlled, it will threaten the sustainability of the South African livestock sector as well as the competitiveness of the sector at large.

4. STUDY RECOMMENDATIONS: PROPOSED CONCEPTUAL FRAMEWORK TO COMBAT STOCK THEFT IN SOUTH AFRICA

Based on the study findings of this paper, the following recommendations are made for consideration by the SAPS management and SAPS STU's commanders in the selected areas of KZN Province:

- Previous research on policing and prevention of stock theft has demonstrated that there is a basic relationship between DNA technology and livestock farming. The available literature highlighted that DNA technology can be used effectively in combating stock theft across South Africa and elsewhere if collected, processed and analysed correctly. Therefore, overall, a new DNA technology in combating stock theft model in South Africa has been conceptualised, based on the presented literature review, documentary analysis, FGDs and KIIs conducted in this study. The DNA technology can be effectively used to combat stock theft in our postmodern society.

A new proposed South African DNA technology conceptual framework in combating stock theft in South Africa envisaged that stock theft can be combated effectively in South Africa with the use of DNA technology and other available conventional methods. The proposed conceptual framework consists of five components, namely:

- Knowledge Management [KM] (focusing on long-term education framework of teachings relating to the current legislative framework on stock theft, such the Animal Identification Act [Act No. 6 of 2002], Stock Theft Act (Act No. 51 of 1959) and other conventional methods used to combat this scourge);
- Available devices in combating stock theft (RFID, ZigBee, WSN, Wi-Fi and DNA technology);

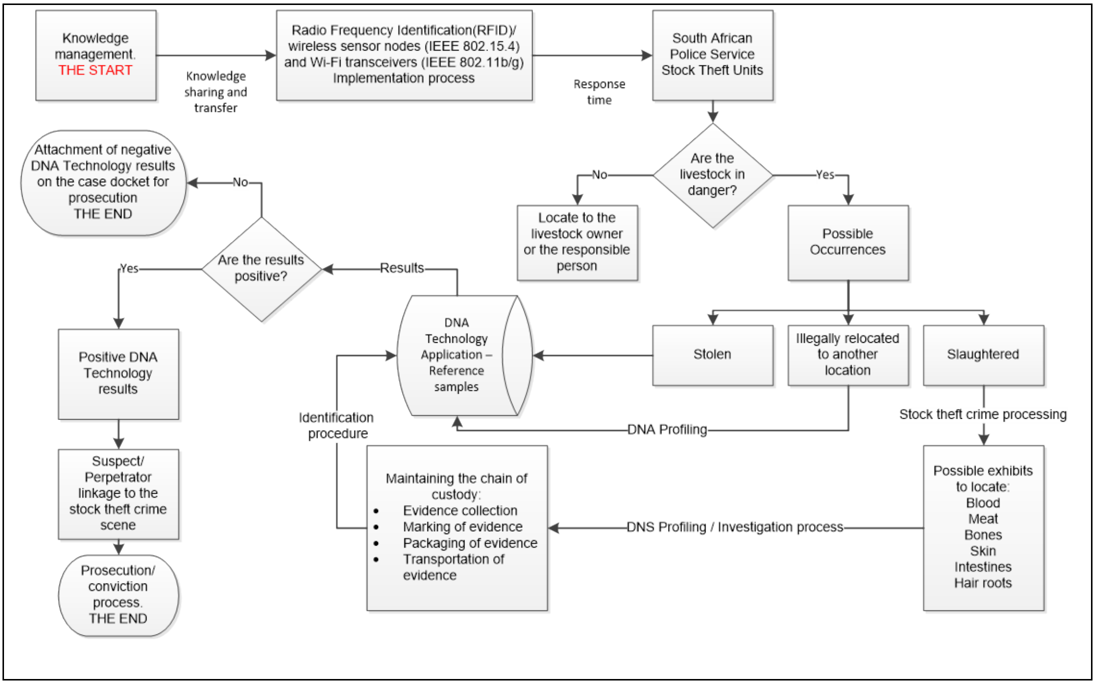
- The preliminary investigation phases (focusing on different types of stock theft scenes, preservation, protection of physical evidence and maintenance of chain of custody);
- DNA Technology analysis (highlighting the importance of using this application and identifying the associated disadvantages); and
- Court procedures and conviction rates (enhancing speedy finalisation of stock theft cases).

The researchers' envisaged that the combination of the listed components can effectively lead to the combating of stock theft in the selected areas of KZN, South Africa. The framework in question further represents the combination of knowledge management, other available technologies (RFID, WI-FI, ZigBee) and DNA technology with integration of conventional methods (brand marking and tattooing) in combating stock theft to cater for both the commercial and emerging farmers in KZN Province.

International identification methods in combating stock theft were considered in the design of the conceptual framework for combating stock theft in South Africa, the selected areas of KZN included. The countries considered included Argentina, Chile, Botswana, Brazil, Malawi, Namibia, Paraguay, Uruguay, Lesotho, Swaziland and South Africa, among others. It was revealed that the majority of the identified countries still rely on conventional means of combating stock theft. Many of the technological systems adopted for use in these countries include ear-tags, either visual ear-tags or ear-tags containing electric microchips with detailed information on each animal and conventional means such as brand marking and tattooing. It is the researcher's view that the proposed new conceptual framework for combating stock theft should be widely distributed and publicised. This will bring forth new methods of combating stock theft in South Africa and other countries, as this scourge is becoming a world problem. Support is required for the development and adaptation of DNA technology models in combating stock theft. The SAPS together with the relevant stakeholders, as identified by the study and others should develop and facilitate the integration of conventional methods of combating stock theft with DNA technology. This should be underpinned by policies and targeted programmes aligned with international standards aimed at enhancing current strategies in combating stock theft in the selected areas of KZN Province and elsewhere through education and training, the provision of knowledge management, relevant Acts and technological advancement.

Furthermore, there should be visible corporate imperatives to manage the risks associated with stock theft and to establish reliable strategies and techniques to address stock theft holistically. Flexibility to act on viable practices for the emerging rural livestock farmers should be maintained, while allowing past research on stock theft to inform present strategies for combating stock theft, and to facilitate the speedy finalisation of stock theft cases.

Figure 2: Schematic representation of a new proposed stock theft Deoxyribonucleic Acid technology conceptual framework for application in combating stock theft in South Africa



Source: Researchers' illustrations

5. CONCLUSION

This study explored how selected SAPS STUs perceive the use of DNA technology in combating stock theft in areas most affected in KZN Province. Findings point to participants having different perceptions of the use of this technology. It was the view of the participants that the majority of local commercial livestock farmers in the selected areas, especially white farmers, use RFID to control and monitor livestock movement within their enclosed facilities.

It was said that this system is regarded by black African emerging livestock farmers as being very expensive. This study therefore introduced the optional combinational of RFID, WSN, Wi-Fi and ZigBee to cater for both livestock farming sectors with the integration of KM. The importance and use of conventional methods in combating stock theft in South Africa were included in this component with more emphasis on the Stock Theft Act (No. 57 of 1959) and the Animal Identification Act (No. 6 of 2002), available technology, investigation phases, DNA technology and court procedures (the components of the proposed conceptual framework – Refer to Figure 2 for detailed illustrations).

The study reveals that DNA technology provides irrefutable proof of wrongful convictions in the past, as well as invaluable links to the actual perpetrators of crimes, with stock theft being no exception. To this end, animal DNA is as personal as a fingerprint, and DNA collected from a crime scene can either link a suspect to evidence or eliminate a suspect. Comparing evidence from one crime scene to that from others enables crimes to be linked nationwide, thereby providing valuable criminal intelligence information to police, and evidence for use in court. As DNA retains its integrity, evidence from crimes committed years previously may yield sufficient DNA for analysis and point to a previously unknown suspect. The researchers' are of the view that the principal link between DNA technology and livestock farming lies in the combating of stock theft, a scourge which is not sufficiently addressed by conventional methods. The consulted literature further reveals that stock theft is a threat to South African livestock producers' very existence, impacting on the long-term sustainability and profitability of the industry. It is hoped that this study has made various empirical and applied contribution by exploring and describing the use of DNA technology in combating stock theft in South Africa.

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