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South African research on livestock theft: a systematic review

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ABSTRACT

Livestock theft is a critical issue in South Africa. The existing research on livestock theft in South Africa remains fragmented and lacks a comprehensive synthesis. This study is a systematic review, and aims to fill this gap by compiling, analysing and synthesizing the existing research on livestock theft in South Africa. The study addresses four key research questions: (1) Theories and models applied to livestock theft research; (2) Methods used in studying livestock theft; (3) Primary dimensions influencing livestock theft; and (4) Gaps in the literature and future research directions. Findings reveal a range of theoretical perspectives applied to the study of livestock theft, including criminological theories like Routine Activity Theory, Crime Pattern Theory, and Rational Choice Theory. These theories offer frameworks for understanding various aspects of livestock theft, such as motives, patterns, and prevention strategies. Methodological diversity is evident, with interviews being the most common approach, alongside literature reviews, secondary data analysis, and focus groups. Gaps in the literature suggest areas for future research, including the integration of theoretical frameworks, adoption of mixed-methods, Design Science Research Methodology (DSRM), and enhanced triangulation of data. There is a call for practical use case studies demonstrating successful implementation of prevention strategies and technologies. Furthermore, understanding the roles of various structures and institutions, including community forums and traditional leaders is crucial for developing effective interventions. In conclusion, the research contributes by consolidating fragmented knowledge on livestock theft and identifying areas for further investigations.

Introduction

This research is part of a thesis. The research is a systematic literature review of existing research on livestock theft that have been undertaken for the past ten years in South Africa. Livestock theft is a critical issue in South Africa, posing significant threats to the agricultural sector, rural livelihoods, and the overall socio-economy. Between 2016 and 2017, livestock theft crimes in South Africa comprised about 11% of all theft related crimes (StatsSA, 2017). This research focuses principally on the most frequently stolen livestock in South Africa, namely cattle, sheep and goats. Cattle, sheep and goats comprise roughly 87% of all livestock stolen in South Africa (Clack, 2018). This is because these animals are of significant socio-economic and cultural value.

Despite the gravity of the livestock theft problem in South Africa, existing research on livestock theft in South Africa remains fragmented and lacks a comprehensive synthesis. The scattered nature of current studies, which vary in focus, methodology, and scope, results in a disjointed body of knowledge. This fragmentation hinders the development of a coherent understanding of the patterns, causes, and effective countermeasures related to livestock theft. Therefore, this research aims to address the critical need for a systematic review of South African research on livestock theft.

This research is organized as follows: The first part is the Introductory section, in which the context and background are briefly described. This is followed by a section that defines livestock theft. A section on the aim, purpose and objectives outlines the nature, scope and focus of this research. The Methodology section is provided, in which search strategies and data sources are

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described. The most important part is the Findings section, in which the results of the systematic review are described and illustrated. Gaps and future directions are presented as a sperate section. The las section concludes the research.

Various countries define livestock theft and categorize livestock theft differently. For instance, in India, livestock theft may refer to cattle raiding, cattle lifting or cattle smuggling; while in Australia, it may refer to duffing (Clack, 2018). In South Africa, livestock theft is categorized as a property crime (SAPS, 2022). Livestock theft here refers to the stealing of livestock (cattle, sheep, goat, horse, donkey, pig, etc.) belonging to another person. The purposes may be for selling, keeping, raising or slaughtering livestock, or for other socio-economic benefits. There is no universal definition or reference as to the identity of a livestock thief. It could be anyone, for instance, a neighbour, farmer, auctioneer, law enforcement officer, youth, foreign national, etc. (Clack, 2018).

This systematic review compiles, synthesizes, analyzes and summaries existing research on livestock theft in South Africa over the past ten years. The research identifies gaps in the existing research on livestock theft in South Africa. The research highlights opportunities for future studies that can provide deeper insights and more effective solutions to the problem of livestock theft. The primary purpose of the research is to provide a comprehensive understanding of the South African research on livestock theft. The aim and purpose of the research are achieved by focusing on the following four research questions:

i. What theories and models have been applied to study livestock theft in South Africa?
ii. What methods have been used to study livestock theft in South Africa?
iii. What are the primary dimensions that influence livestock theft in South Africa?
iv. What future research directions can be recommended from the research gaps?

Research and Methodology

Procedures

The research uses the publicly available data and information from journal articles, reports, conference proceedings, dissertations, books, theses, uses cases, etc. The search for data and information was initiated through the use of academic databases including the Web of Science (previously Web of Knowledge), Scopus, Science Direct, IEEE explorer, Sabinet, ACM Digital Library, AACE Digital Library, ProQuest, and a scholarly search engine known as Google Scholar. These databases were chosen because of their wide coverage of relevant literature and advanced bibliometric features such as suggesting related literature or citations. The combinations of groups of various keywords such as ‘livestock theft’, ‘stock theft’, ‘theft of livestock’, ‘cattle theft’, ‘sheep theft, ‘goat theft, ‘cattle rustling’, ‘cattle raiding’, and ‘South Africa’ were used as search queries/keywords.

A combination of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method, snowball strategy, and Critical Appraisal Skill Programme (CASP) was adopted as the framework to support the systematic review for this research. The combination of these review methods was adopted in order to strengthen the credibility, dependability, confirmability and transferability for this research study. A combination of various methods strengthens the accuracy and transparent reporting of research findings (Macnee & McCabe, 2008). The justification for the selection and application of Scoping Review Method, snowball strategy, PRISMA, and CASP is described in the sub-sections below.

Preferred reporting items for systematic reviews and meta-analyses

The PRISMA enhances the credibility of the review by providing a clear framework for conducting and reporting the systematic search, selection, extraction, and synthesis of data from relevant studies (Gough et al, 2017; Moher et al 2009). The workflow of the PRISMA is described below.

i. *Identification:* At this stage, the literature search for this research was initiated through the use of academic databases and search queries/keywords previously stated in section 4.1. At this stage, records were manually screened, and then duplicate records were identified and removed.

ii. *Screening:* Titles, abstracts, and keywords in the scholarly items (journal articles, conference papers, books, etc), and non-scholarly items (reports, news, magazines and blogs) guided the screening and use of eligibility criteria. Only items that were relevant to livestock theft research within the South African context were considered in this phase.

iii. *Eligibility:* The Critical Appraisal Skill Programme (CASP) became relevant at this stage. At this stage, the researcher applied CASP to assess the eligibility and quality of articles.

iv. *Included:* At this stage, records were grouped into three categories according to their relevance to the current research study: relevant records, partially relevant records, other relevant records. Only items written in English language in the past 10 years (i.e. between 2013 and 2023) were included. This made it possible to have a detailed study carried out on the articles during the qualitative synthesis activity in the final stage.

Snowball strategy

A snowball strategy is based on a thorough review of each article's references. It was used to identify other relevant peer-reviewed literature. The inclusion of snowball strategy in this chapter is in alignment with the explanations provided by Bread University of Applied Science (2022). According to Bread University of Applied Science (2022), snowball strategy is a process of tracking down references or citations in documents. The author then examines the bibliographies of these new publications to find yet more relevant titles (Bread University of Applied Science, 2022).

Critical appraisal skill programme

According to OAP Ltd (2022), CASP is useful when an author seeks to carefully and systematically examine a related published research study or paper regarding the topic. The critical appraisal process allows the author to judge the trustworthiness and value of the published research study, on the one hand. On the other hand, the CASP enables the author to evaluate relevance and results in a particular context. This becomes essential for a quality evidence-based literature review (OAP Ltd, 2022). For this purpose, the "CASP Checklist" was used as a guide to carefully and systematically examine the research studies and papers used in this chapter. The CASP template used in this research is shown in appendix A.

Results and Discussion

Theoretical and Model Perspectives

This systematic review of South African research on livestock theft reveals that various researchers have attempted to study livestock theft from different theoretical/model perspectives. The findings reveal that most researchers have researched livestock theft from a criminological theoretical perspective. Through the application or explanation of theories, they have sought to study the nature, dimensions, causes, motives, and preventative strategies of livestock theft.

Breetzke et al. (2023) applied the *Routine Activity Theory* to explore the causal and contributory factors in the occurrence of livestock thefts. In contrast, Clack (2015) applied a combination of *Routine Activity Theory, Crime Pattern Theory, Rational Choice Theory* and *Buffer Zone* to analyze livestock theft cases in South Africa. Doorewaard (2020), in her study on criminal behaviour associated with livestock theft, applied the same criminological theories. Masuku and Motlalekgosi (2022) explain how the *Broken Window Theory* and *Social Bond Theory* can be used to study the phenomenon of livestock theft. Müller (2016) highlights the applicability of crime prevention models to livestock thefts. Mears et al. (2007) applies *Crime Opportunity Theory* to study theft of livestock. Müller (2016) explains how *Neutralisation Theory* fits into the context of livestock thefts. Müller (2016) also demonstrates how the *Disaster Pressure and Release (PAR) model* can be applied to study livestock thefts. In the same paper, Müller (2016) explains the models of combating crime in the context of livestock thefts.

The study conducted by Swardt & Kamper (2022), which applies time series machine learning techniques to analyze Global Positioning System (GPS) data for livestock theft detection, is fundamentally different when compared to studies grounded in theories from Philosophy, Politics, Criminology, and Disaster Management. In terms of perspective the study can be viewed as Data Science based. The study on modelling the typical behaviour of a cow, conducted by Nkwari et al (2014) can be viewed as a Mathematical perspective.

The highlight of these studies is that the theories provide a framework for researching livestock theft crimes in terms of six basic questions: "what", "where (location)", "when", "who", "how", and "why". The theories previously applied to study livestock theft in South Africa can be categorized into criminology, disaster management, sociology, physiology and economics, data science, and mathematics, as synthesized and summarized in table 1 below. In table 1 below, the terms Concept 1, Concept 2, Concept 2, Concept 3, Concept 4, Concept 5 refer to the building blocks of a theory.

Table 1: Theories and models previously applied to South African research on livestock theft

Theory or Model	**Category**	**Concept 1**	**Concept 2**	**Concept 2**	**Concept 3**	**Concept 4**	**Concept 5**
Routine Activity Theory (Breetzke et al., 2023).	Criminology.	Offender.	Suitable target.	Absence of guardian.	--------	--------	--------
Crime Pattern Theory (Clack, 2015).	Criminology.	Nodes.	Paths.	Edges.	--------	--------	--------
Rational Choice Theory (Clack, 2015).	Criminology, Eeconomics, Psychology, Philosophy, Politics.	Rational actors.	Self interest.	Invisible hand.	--------	--------	--------
General Strain Theory (Doorewaard, 2020).	Criminology.	Failure to achieve positively valued goals.	Removal of positive stimuli.	Introduction of negative stimuli.	--------	--------	--------
Broken Window Theory (Masuku and Motlalekgosi, 2022).	Criminology.	Informal social controls.	Role of fear.	Difference with zero tolerance.	--------	--------	--------
Social Bond Theory.	Criminology.	Attachment.	Commitment.	Involvement.	Common values.	--------	--------
Social Learning Theory Learned experiences.	Physiology.	Learned experiences.	Attention.	Retention.	Reproduction.	Motivation.	
Buffer Zone Theory (Clack, 2015).	Criminology.	Topographic factors.	--------	--------	--------	--------	--------
Neutralisation Theory (Müller, 2016).	Criminology.	Denial of responsibility.	Denial of injury.	Denial of the victim.	Condemnation of the condemners.	Appeals to higher loyalties.	--------
Crime Prevention Models (Müller, 2016).	Criminology.	Conservative model.	Liberal model.	Radical model.	--------	--------	--------
PAR Model (Müller, 2016).	Disaster Management.	Unsafe conditions	Dynamic pressures.	Root causes.	--------	--------	--------
Livestock Trajectory Embedding (LTE) Model (Swardt & Kamper, 2022).	Data Science.	Convolutional layers.	Deconvolutional layers.	Autoencoder	--------	--------	--------
Random walk model (Nkwari et at, 2014)	Mathematical.	Path.	Random steps.	--------	--------	--------	--------

Source: Author's own illustration, based Research Question 1 and on synthesized theories and models previously applied to research on livestock theft

Methods that have been used to study livestock theft in south africa

The findings of this systematic review reveal a diverse array of methods, with interviews being the most prevalent. For instance, Breetzke et al. (2023) utilized interviews and group conversations to explore the economic drivers behind livestock theft, finding that economic factors are significant contributors. Similarly, Maluleke (2021) employed focus groups, key informant interviews, and observation schedules to gather perspectives on theft prevention, highlighting a lack of effective preventative measures and a loss of confidence in the police. Other studies, such as those by Pasiwe et al. (2021) and Masuku & Motlalekgosi (2021), also relied on interviews to assess the socio-economic impact of theft on victims and the role of community policing, respectively, emphasizing the psychological stress experienced by victims and the poor relationship between communities and law enforcement.

In addition to interviews, literature reviews have been a common method for analysing livestock theft in South Africa. Maluleke et al. (2022) reviewed existing literature to assess the impact of restricted patrolling during the lockdown on livestock branding and tattooing, finding inadequate use of technologies. Zantsi and Nkunjana (2021) conducted a literature review to explore the potential of GPS tracking devices for mitigating stock theft, noting a lack of empirical research on farmers' awareness and willingness to adopt such technology. Secondary data analysis was used by Clack (2018) and Geldenhuys (2020) to examine the extent of livestock theft and its criminal associations, revealing regional differences in theft prevalence and the organized nature of the crime. These varied methods underscore the multi-faceted nature of livestock theft research and the need for comprehensive approaches to understand and address this persistent issue. The diverse array of methods is illustrated in column 'Method' in table 2 below.

Table 2: Methods that have been previously used to study livestock theft in South Africa

Author	Main Theme	Method
Breetzke et al. (2023).	Contributory factors to the occurrence of livestock thefts.	Interviews. Group conversations.
Maluleke et al. (2022).	Livestock theft contributory factors during the lockdown.	Literature review.
Swardt & Kamper (2022).	Distinguish between four categories of trajectories: theft, predation, own handling and other.	GPS Dataset. Machine learning.
Maluleke (2021).	Perspectives on livestock theft prevention.	Focus Groups. Key Informants. Interviews. Observation Schedules.
Zantsi S; Nkunjana (2021).	Possibilities for using animal tracking devices to mitigate stock theft.	Literature review.
Pasiwe et al. (2021).	Socio-economic impact of stock theft on victims.	Interviews.
Masuku & Motlalekgosi (2021).	Community policing and livestock theft.	Interviews.
Doorewaard (2020).	Criminal behaviour associated with livestock theft.	Interviews. Dockets.
Geldenhuys (2020).	Livestock theft: a costly, cruel crime.	Secondary data.
Maluleke (2020).	Drones in policing livestock theft.	Interviews.
WA & Bahta (2019).	Estimate Financial Impact of livestock theft in one province of South Africa.	Interviews. Questionnaires. Quantification of direct and indirect costs.
Maluleke (2019).	Cross-border crimes.	Systematic review of literature.
Maluleke (2019).	DNA evidence to link a suspect to stock theft scenes.	Interviews.
Clack (2018).	Livestock is a global problem.	Secondary data.
Clack (2018).	Livestock thefts as primary crimes in rural areas.	Secondary data.
Clack (2018).	Non-reporting of livestock theft by farmers.	Secondary data.
Lombard & van Niekerk (2017).	Role of unmarked livestock.	Secondary data.
National Stock Theft Prevention Forum (2015).	Guide to the prevention and handling of livestock theft	Secondary data.
Nkwari et al (2014)	The predictive model allows can prevent livestock theft in farms.	Continuous Time Markov Processes (CTMP).
Maluleke et al. (2016).	Extent, impact, dark figures and problems areas of stock theft.	Secondary Data. Focus Group Discussions (FGD), Interviews with the Key Informants (KII) and Observations schedule through court session attendance.

Muller (2016).	Magnitude of livestock theft.	Questionnaires.
Lombard (2016).	Quantify the financial impact of livestock theft.	Questionnaires. Quantification of the direct and indirect costs of losses to livestock theft.
Clack (2015).	Uniqueness of livestock theft as a rural crime.	Livestock theft cases.
Clack (2015)	Role of social media in livestock theft.	Case studies from the Facebook social media group.
Maluleke et al. (2014).	Assessment of Policing and Prevention Strategies of Stock Theft.	Interviews.
Clack (2013).	Extent of Livestock Theft.	Exploring the reported cases of livestock theft.
Zwane et al. (2013).	Role of DNA in livestock theft.	Literature Review.

Source: Author's own illustration based Research Question 2 and on the scholars and year of publications that are listed in the first column.

Primary dimensions that influence livestock theft in south africa

This systematic review of South African research on livestock theft reveals a variety of primary dimensions that influence livestock theft in the country. The primary dimensions influencing livestock theft in South Africa are multifaceted, encompassing socio-economic, technological, law enforcement, geographic, cultural, and organized crime factors. Economic factors are identified as primary drivers of livestock theft, as highlighted by Breetzke et al. (2023), Pasiwe et al. (2021), WA & Bahta (2019), Clack (2018), Muller (2016) and Clack (2013). Furthermore, the socio-economic impact of livestock theft extends beyond financial losses, causing psychological distress among victims (Pasiwe et al., 2021). The socio-economic pressures are exacerbated by a lack of effective preventative measures and a general loss of confidence in law enforcement, as reported by Maluleke (2021) and the National Stock Theft Prevention Forum (2015).

Technological factors play a crucial role in livestock theft. The restricted use of branding and tattooing during the lockdown (Maluleke et al., 2022) and the inadequate adoption of advanced technologies like drones and GPS tracking devices (Maluleke, 2020; Zantsi & Nkunjana, 2021) highlight the technological gaps in livestock management and theft prevention. Law enforcement and legal factors are also pivotal, with issues such as inadequate policing, poor community-police relations, and ineffective legal frameworks being recurrent themes in the literature (Masuku & Motlalekgosi, 2021; Lombard & van Niekerk, 2017).

Geographic factors, including the prevalence of livestock theft in remote and border areas, further complicate enforcement efforts (Clack, 2018; Maluleke, 2019). Cultural factors, such as community attitudes toward theft and non-reporting of incidents, also play a significant role (Clack, 2018). The organized nature of livestock theft, involving cross-border crimes and diverse perpetrators underscores the complexity and scale of the issue (Doorewaard, 2020; Geldenhuys, 2020). Together, these dimensions highlight the multifaceted and complex nature and dynamics of livestock theft in the country. Hence there is a need for a comprehensive synthesis to guide effective interventions in addressing livestock theft in South Africa. The primary dimension that emanated from the South African research on livestock theft are summarised in table 3 below.

Table 3: Primary dimensions that influence livestock theft in South Africa

Author	Key Highlights	Primary Dimension
Breetzke et al. (2023).	Economic factors are the main drivers of livestock-theft.	Socio-Economic Factors.
Maluleke et al. (2022).	Restricted patrolling of livestock farms in South Africa. Limited livestock branding and tattooing. Inadequate use of technologies	Law Enforcement Factors. Technological Factors.
Maluleke (2021).	Lack of appropriate preventative measures. Loss of confidence toward the police.	Law Enforcement and Legal Factors.
Zantsi S; Nkunjana (2021).	Empirical research on the level of awareness among communal (smallholders and sustenance) about GPS animal tracking devices and whether these farmers would be willing to adopt this technology does not exist.	Technological Factors.
Pasiwe et al. (2021).	Victims of livestock theft are more likely to suffer from psychological stress and Post-Traumatic Stress Disorder (PTSD).	Socio-Economic Factors.
Masuku & Motlalekgosi (2021).	Lack of community involvement in the fight against stock theft. Poor relationship between the SAPS and the community in combating stock theft.	Law Enforcement and Legal Factors. Cultural Factors.

Doorewaard (2020).	Livestock theft is of organised nature, and perpetrators come from diverse backgrounds.	Organized Crime. Socio-Economic Factors
Geldenhuys (2020).	Organized crime. Cross-border stock theft. Scams associated with. livestock theft. Violence associated with livestock theft. Technology in stock theft. Identification of livestock. DNA technology. Policing problems.	Organized Crime. Technological Factors, Law Enforcement and Legal Factors.
Maluleke (2020).	Inadequate related knowledge and application of the use of drones.	Technological Factors.
WA & Bahta (2019).	Estimated total was R 303 858 556.	Socio-Economic Factors
Maluleke (2019).	Livestock theft is a common cross-border crime and highly organised in nature.	Organized Crime. Geographic Factors
Maluleke (2019).	Accuracy of DNA application is beyond doubt, when done in the correct way.	Technological Factors.
Clack (2018).	Livestock theft differs in extent between regions, provinces, countries and continents	Geographic Factors.
Clack (2018).	Livestock theft represents the biggest economic and crime impact on rural economies.	Socio-Economic Factors.
Clack (2018).	Various reasons for the non-reporting.	Cultural Factors.
Lombard & van Niekerk (2017).	Unmarked livestock can cause stock thieves to be found innocent in court, because it is impossible to prove ownership of the animals	Law Enforcement and Legal Factors.
National Stock Theft Prevention Forum (2015).	Safety tips. Livestock branding. Relevant legislation.	Law Enforcement and Legal Factors.
Maluleke et al. (2016).	There is no single solution tailor-made to fight against livestock theft.	Law Enforcement and Legal Factors.
Muller (2016).	Various factors contribute to livestock theft.	Socio-Economic Factors.
Lombard (2016).	Livestock theft has a major financial impact on the livestock industry	Geographic Factors, Law Enforcement and Legal Factors
Clack (2015).	Livestock theft needs to be attended to in a more specialised manner than other crimes against property in rural areas.	Technological Factors.
Clack (2015)	Identify possible livestock theft suspects. Identify the interrelationships between the various role-players. Contribution to the apprehension of offenders. Locating of stolen livestock and the identification and tracking of owners.	Technological Factors.
Maluleke et al. (2014).	Cloud of no confidence exists toward the police amongst the affected livestock farmers and community members.	Law Enforcement and Legal Factors
Clack (2013).	Create awareness of livestock theft. Recommendations for possible new research topics.	Socio-Economic Factors, Cultural Factors
Zwane et al. (2013).	Nationally, animal forensic and dispute cases have been resolved through DNA. DNA forensics is a long and costly process.	Technological Factors

Source: Author's own illustration, based Research Question 3 and on the scholars and year of publications that are listed in the first column.

Gaps and future research directions

The identified gaps and future research directions can be classified into (i) theoretical perspective; (ii) methodological perspective; (iii) triangulation research perspective; (iv) national quantitative research perspective; (v) use case perspective; (vi) empirical research perspective; (vii) formal and informal structures and institutions; (viii) business case perspective; (ix) interdisciplinary/multi-disciplinary perspective; and (x) Political, Social Economic, Technological, Legal and Environmental (PSETLE) perspective; and (xi) national livestock information system address livestock theft.

Theoretical perspective

Despite the breadth of theoretical frameworks, there is a noticeable gap in integrating the identified theories into a cohesive framework that can provide a more comprehensive understanding of livestock theft. Future research should aim to develop an integrated theoretical model that combines elements from multiple theories to better capture the complexity of livestock theft. A research from an Information Systems (IS) perspective can be adopted to better capture the complexity of livestock theft. This is

because of the multi-disciplinary nature of IS. For instance, an IS oriented theory called Actor Network Theory (ANT) can offer unique insights into the complex network of human and non-human actors involved in livestock theft (Latour, 2007).

Methodological perspective

The predominant reliance on criminological theories in the existing literature indicates a strong methodological focus on qualitative approaches, such as interviews and literature reviews. However, there is a significant gap in employing mixed-methods research that combines qualitative insights with quantitative data. Future studies should adopt a mixed-methods approach to provide a more robust analysis of livestock theft, incorporating both qualitative and quantitative data to validate findings and enhance generalizability. In the literature, there is a lack research on the adoption of Design Science Research Methodology (DSRM) to study livestock theft in South Africa. Using Design Science Research Methodology (DSRM) to study livestock theft in South Africa would involve creating and evaluating innovative solutions to address the problem. DSRM focuses on designing artifacts that solve practical problems and contribute to knowledge (Peffers, 2007). Future studies could adopt DSRM to study livestock theft.

Triangulation research perspective

Triangulation is sparsely utilized in the current research landscape on livestock theft. The integration of multiple data sources, methods, and theoretical perspectives can offer a more nuanced and reliable understanding of the issue. Future research should focus on triangulating data from various sources, such as police reports, farmer interviews, and technological tracking data, to validate findings and provide a more holistic view of livestock theft patterns and drivers.

Use case perspective

Practical applications of research findings are limited in the current literature. There is a need for more use case studies that demonstrate successful implementation of prevention strategies and technologies in real-world settings. For instance, there is limited research on DNA case uses, and drone use cases. Future research should document and analyze specific use cases where innovative solutions have been effectively deployed, offering practical insights and guidelines for broader application.

Structures and institutions

There is a gap in understanding the roles of structures and institutions such as community virtual groups, traditional leaders, and community-based forums in combating livestock theft. Future research should examine how these structures interact and contribute to prevention efforts, identifying best practices and areas for improvement in institutional collaboration and community engagement.

Business case perspective

The economic impact of livestock theft on businesses and the broader agricultural sector is not sufficiently explored. Future research should develop detailed business case analyses that quantify the financial losses and cost-benefit ratios of various prevention strategies, helping stakeholders make informed decisions about investments in security measures and technologies.

Interdisciplinary/Multidisciplinary perspective

Visible Policing (2019) ‘calls’ for the multidisciplinary approach for a comprehensive and holistic strategy to support the creation of a safe rural environment that combats theft of livestock. Despite this ‘call’, there is lack research studies that have proposed a national conceptual framework for multidisciplinary approaches towards combating livestock theft. The current research is predominantly criminological, with limited interdisciplinary collaboration. Future studies should incorporate perspectives from IS and information science to provide a more comprehensive understanding of livestock theft. Multi-disciplinary approaches can uncover new dimensions and innovative solutions to the problem.

Political, social economic, technological, legal and environmental (PSETLE) perspective

A holistic PSETLE analysis is largely absent in the reviewed literature. Future research should adopt a PSETLE framework to examine the political, social, economic, technological, legal, and environmental factors influencing livestock theft. This comprehensive approach can reveal interdependencies and inform multi-faceted strategies for livestock theft prevention and intervention.

National livestock ICT-based information system to address livestock theft

Identification of livestock and tracking of lost, stolen, or otherwise missing livestock remains a challenge in South Africa (Cilliers, 2019; Lombard & van Rooyen, 2017). Several research institutions have called for the utilization of ICTs to address livestock identification and tracking in the country (Moolman, 2017). Despite this ‘call’, there is a lack of studies proposing a national livestock identification and tracking ICT-based information system. Future studies could develop a conceptual model of a national livestock identification and tracking ICT-based information system.

Conclusion

The study highlights the critical issue of livestock theft in South Africa. The crime statistics from South African Police Services (SAPS) show that livestock theft occurs in all the provinces of the country (SAPS, 2022). This is a clear indication that livestock is

a serious national problem. Cattle, sheep and goats are the most frequently stolen livestock in the country due to their significant socio-economic and cultural value. Despite the importance of addressing livestock theft, existing research in South Africa remains fragmented, lacking a cohesive synthesis. This systematic review south to highlight the pressing need for a cohesive and comprehensive understanding of livestock theft in South Africa. This research fills a crucial gap by systematically reviewing and synthesizing the existing literature. The study's findings and identified gaps highlight the need for future research that can offer deeper insights and more effective solutions, ultimately contributing to the formulation of robust strategies to combat livestock theft in the country.

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References

Bread University of Applied Science. (2022). *Information Skills Toolbox*. Retrieved September 3, 2022, from https://buas.libguides.com/c.php?g=670074&p=4776470

Breetzke, G. D., Mosesi, N., & Bester, P. (2023). The 'contestation of crime': Using a spatial theory of crime to examine livestock theft among small-scale farmers in Swartruggens, North West province. *South African Geographical Journal, 105*(2), 262–275.

Cilliers, I., & Tshabalala, T. (2019). Tackling rural crime in Gauteng. Retrieved February 2, 2021, from https://www.rpo.co.za/wp-content/uploads/2016/04/Conference-Paper-Rural-Crime-Cilliers.pdf

Clack, W. (2013). The extent of stock theft in South Africa. *Acta Criminologica: Southern African Journal of Criminology, 26*(2), 77–91.

Clack, W. (2018). Livestock theft: A global and South African perspective. *Stock theft report presented at the National Red Meat Producers Congress*, 11–12.

Clack, W. (2020). Livestock theft prevention. In *Rural Crime Prevention* (pp. 205–219). Routledge.

Clack, W. J. (2015). Criminology theories: An analysis of livestock theft cases. *Acta Criminologica: African Journal of Criminology & Victimology, 28*(2), 92–106.

Clack, W. J. (2015). The role of social media in livestock theft: A case study. *Acta Criminologica: African Journal of Criminology & Victimology, 28*(1), 112–127.

Clack, W., & Minnaar, A. (2018). Rural crime in South Africa: An exploratory review of 'farm attacks' and stock theft as the primary crimes in rural areas. *Acta Criminologica: African Journal of Criminology & Victimology, 31*(1), 103–135.

Clack, W., & Schutte, J. (2015). Livestock Theft: A Crime Wave Affecting Red Meat Producers. South Africa: National Stock Theft Prevention Forum. Retrieved February 2, 2021, from http://www.rpo.co.za/News/tabid/9975/id/1401/Default.aspx

De Swardt, U., & Kamper, H. (2022). How machine learning can aid South African farmers' security: Unsupervised livestock trajectory embeddings. In *Proceedings of the South African Conference on AI Research* (pp. 54–66).

Doorewaard, C. (2020). The progressive and persistent nature of livestock theft. *Servamus Community-based Safety and Security Magazine, 113*(3), 28–29.

Geldenhuys, K. (2020). Stock theft: A costly, cruel crime. *Servamus Community-based Safety and Security Magazine, 113*(3), 14–20.

Gough, D., Thomas, J., & Oliver, S. (2017). *An introduction to systematic reviews* (2nd ed.). Sage.

Latour, B. (2007). *Reassembling the social: An introduction to actor-network-theory*. Oxford University Press.

Lombard, W. (2020). Livestock theft: The short end of the stick. *FarmBiz, 6*(5), 6–7.

Lombard, W. A. (2016). *The financial impact of sheep theft in the Free State Province of South Africa* (Master's thesis). University of the Free State.

Lombard, W. A., & Van Niekerk, H. N. (2016). Livestock theft breaks farmers' backs issues. *Stockfarm, 6*(1), 10–13.

Lombard, W. A., & Van Niekerk, H. N. (2016). Livestock theft can break the camel's back. *FarmBiz, 2*(2), 14–17.

Lombard, W. A., & Van Rooyen, F. M. (2017). Stock theft trends and the role of unmarked livestock. *Stockfarm, 7*(4), 8–9.

Lombard, W. A., Van den Heever, M., & Jammer, B. (2018). The role of livestock identification in farming. *Stockfarm, 8*(4), 8–9.

Macnee, C. L., & McCabe, S. (2008). *Understanding nursing research: Using research in evidence-based practice*. Lippincott Williams & Wilkins.

Maluleke, W. (2017). Justice for rural livestock farmers in Giyani Policing Area. *Asian Journal of Applied Sciences, 5*(5).

Maluleke, W. (2018). The integration of conventional and technological methods in combating stock theft by selected stakeholders in the KwaZulu-Natal Province. *Acta Criminologica: African Journal of Criminology & Victimology, 31*(4), 123–146.

Maluleke, W. (2020). The use of drones in policing stock theft by the selected rural South African livestock farmers. *Journal of the Social Sciences, 48*(4), 633–652.

Maluleke, W. (2021). A proposed method to effectively combat stock theft: Lessons for the South African Criminal Justice System. *European Journal of Economics, 5*(2).

Maluleke, W., & Dlamini, S. (2019). The prevalence of organised cross-border crimes in South Africa: A non-empirical statistical data analysis on stock theft and hijacking of motor vehicles. *International Journal of Social Sciences and Humanity Studies, 11*(1), 116–145.

Maluleke, W., & Mofokeng, J. T. (2016). The use of deoxyribonucleic acid in combating stock theft: Experiences and recommendations of South African Police Service KwaZulu-Natal selected stock theft units. *International Journal of Business and Management Studies, 8*(1), 50–69.

Maluleke, W., Mokwena, R. J., & Motsepa, L. L. (2016). Rural farmers' perspectives on stock theft: Police crime statistics. *South African Journal of Agricultural Extension, 44*(2), 256–274.

Maluleke, W., Mphatheni, M. R., & Nkosi, S. L. (2022). A systematic study on stock theft contributory factors during the South African lockdown. *International Journal of Research in Business and Social Science, 11*(2), 462–476.

Maluleke, W., Obioha, E. E., & Mofokeng, J. T. (2014). Assessment of policing and prevention strategies of stock theft in South Africa: A case study of Giyani Policing Area, Republic of South Africa. *Mediterranean Journal of Social Sciences, 5*(23), 2148.

Masuku, S., & Motlalekgosi, P. (2022). Lack of community participation in the fight against stock theft in Dr. Pixley ka Isaka Seme Municipality, South Africa: What went wrong? *International Journal of Research in Business and Social Science, 11*(4), 267–274.

Mears, D. P., Scott, M. L., & Bhati, A. S. (2007). Opportunity theory and agricultural crime victimization. *Rural Sociology, 72*(2), 151–184.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & PRISMA Group. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *Annals of Internal Medicine, 151*(4), 264–269.

Müller, G. S. (2016). *Magnitude of livestock theft in Kwa Sani and factors that could influence it* (Master's thesis). University of the Free State.

National Stock Theft Prevention Forum. (2015). *Manual for the Prevention of Stock Theft*. Retrieved from https://www.elsenburg.com/wp-content/uploads/2022/02/Stock-theft-manual.pdf

Nkwari, P. K. M., Rimer, S., & Paul, B. S. (2014, May). Cattle monitoring system using wireless sensor network in order to prevent cattle rustling. In *2014 IST-Africa Conference Proceedings* (pp. 1–10). IEEE.

OAP Ltd. (2022). *Critical Appraisal Checklists*. Retrieved from https://casp-uk.net/casp-tools-checklists/

Pasiwe, Q. S., Earl-Taylor, M., & Sinefu, A. (2021). Unintended consequences of stock theft on victims: Findings from Alice, Amathole District, Eastern Cape, South Africa. *Acta Criminologica: African Journal of Criminology & Victimology, 34*(1), 154–169.

Peffers, K., Tuunanen, T., Rothenberger, M. A., & Chatterjee, S. (2007). A design science research methodology for information systems research. *Journal of Management Information Systems, 24*(3), 45–77.

SAPS. (2022). *SAPS Crimestats*. Retrieved October 9, 2022, from https://www.saps.gov.za/services/crimestats.php

StatsSA. (2017). *Victims of Crime Survey 2016/17*. Retrieved January 2, 2017, from https://www.statssa.gov.za/publications/P0341/P03412016.pdf

Visible Policing. (2019). *The National Rural Safety Strategy*. Retrieved January 18, 2021, from https://www.saps.gov.za/resource_centre/publications/national_rural_safety_strategy_2019.pdf

WA, L., & Bahta, Y. T. (2019). Stock theft control mechanism and economic impact of livestock theft in the Free State Province of South Africa: Implication for agricultural management policies. *International Journal of Agricultural Management, 8*(3), 98–106.

Zantsi, S., & Nkunjana, T. (2021). A review of possibilities for using animal tracking devices to mitigate stock theft in smallholder livestock farming systems in rural South Africa. *South African Journal of Agricultural Extension, 49*(1), 162–182.

Zwane, A. A., Marle-Köster, E. V., Greyling, B. J., & Mapholi, N. (2013). A review: Forensic DNA technology to meet the stock theft challenges in South Africa. *Applied Animal Husbandry & Rural Development, 6*(1), 36–47.