

The Role of Enterprise Information Systems (EIS) in the Advancement of Livestock Production and Marketing in the Drylands: A Case of Turkana County in Kenya

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Abstract: The livestock sector plays a critical role in supporting livelihoods in arid and semi-arid lands (ASALs), yet it faces significant challenges arising from recurrent droughts, insecurity, weak market systems, and limited adoption of modern technologies. This study examined the potential of technology-driven integration of livestock production and marketing through the implementation of Enterprise Information Systems (EIS). An exploratory research design employing mixed methods was adopted. Data were collected from eight primary and secondary livestock markets in Turkana County through focus group discussions involving market management committees and stakeholders. Secondary data and literature on Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), Supply Chain Management (SCM), Business Intelligence (BI), and other enterprise systems were reviewed and validated through consultations with livestock traders, government officials, civil society actors, and researchers. The findings revealed substantial technological deficiencies in livestock marketing, including manual record-keeping, poor data management, limited market transparency, weak stakeholder communication, and inadequate decision-support mechanisms. These challenges contribute to inefficiencies, increased operational costs, poor compliance with livestock health regulations, and reduced market competitiveness. The study established that integrating Enterprise Information Systems, Livestock Management Information Systems (LMIS), Geographic Information Systems (GIS), mobile-based market platforms, and Decision Support Systems (DSS) can significantly enhance livestock production and marketing by improving traceability, market access, data-driven decision-making, and operational efficiency. The proposed EIS framework incorporates data integration, reporting tools, security controls, collaboration platforms, SCM, CRM, and transaction processing systems to strengthen the livestock value chain. The study concludes that technological adoption is essential for the sustainable development and commercialization of Turkana's livestock sector and recommends phased implementation of integrated digital solutions supported by capacity building, infrastructure development, and enabling policies.

Keywords: *Enterprise Information Systems, Enterprise Resource Planning, Livestock production, Livestock marketing, Technology integration, Market performance, Arid and Semi-Arid Lands (ASALs).*

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Introduction

The dryland areas of Kenya experience the highest per capita livestock population and have historically managed droughts through herd splitting and migration. Increased drought frequency has led to significant livestock losses and economic struggles for pastoralists, compounded by insecurity and resource conflicts. Dependency on humanitarian aid is rising, pushing some pastoralists towards crop farming. The livestock marketing system is complicated, with long-distance transportation exposing livestock and traders to risks like weight loss, theft, disease, and insecurity. Most livestock sold, including sheep, goats, cattle, and camels, primarily serve the internal market, while the export market remains undeveloped. Low agricultural technology adoption hinders economic growth in the sector.

Modern technology in agriculture, particularly through methods like GPS precision farming, can enhance productivity in breeding, feeding, marketing, and processing. However, agriculture still lags behind other sectors, leading to diminished dignity for

farmers and poor working conditions. These technological deficiencies threaten livestock production and marketing in dryland areas. An Enterprise Information System (EIS) offers a sustainable, technology-based solution, integrating essential information to enhance farm and market operations and improve decision-making. The EIS promotes efficiency and communication across departments, boosting overall business performance.

In dryland areas, the livestock industry requires integration, centralized data management, real-time information access, scalability, and automation to enhance efficiency and profitability. The implementation of Enterprise Information Systems (EIS), including Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), and Business Intelligence (BI) alongside Supply Chain Management (SCM), will streamline core business functions, improve customer relations, facilitate the coordination of goods and services, support strategic decision-making, and enhance production and distribution efficiency.

Literature Review

Importance of Knowledge of Information Systems

The 21st century is characterized by the emergence of *Homo Conexus*, a generation whose activities and interactions are increasingly shaped by information technologies and networked societies. Ongoing developments in Information and Communication Technology (ICT), Information Technology (IT), and internet connectivity have significantly enhanced organizational efficiency, business administration, and management practices (Coşkun et al., 2022; Anno et al., 2023). As globalization intensifies and technology becomes a key determinant of precision, competitiveness, and profitability, organizations face challenges related to technology development, acquisition, maintenance, outsourcing, and system failures. Businesses that are unable to effectively manage these technological complexities risk losing their competitive advantage.

Management Information Systems (MIS) have evolved to address these challenges by supporting organizational functions across departments and facilitating business growth, integration, and coordination. According to Lei and Sun (2020) and Singh, Singh, and Misra (2022), MIS enables organizations to develop scalable business portfolios, integrate diverse business components, and centrally coordinate operations through efficient information management tools.

Technology and Business Performance

Business performance is increasingly dependent on technological systems that provide operational support, knowledge development, and management services. Enterprise Information Systems (EIS) and their integrated applications contribute to organizational structure, coordination, and resilience, enabling businesses to respond effectively to environmental pressures and risks while gaining competitive advantages (Osnes et al., 2018; Salih et al., 2022; Anno and Pjero, 2021). Thomas Friedman's globalization theory identifies three major eras of globalization, with the current era characterized by technology-driven interconnectedness. Information technology empowers organizations by enhancing customer relationship management, improving productivity, and enabling global collaboration. In developing countries, technological innovations have transformed workforce capabilities and business operations.

Malik and Khan (2020), in their study on Enterprise Resource Planning (ERP) implementation in developing countries, emphasize that technological innovation requires organizations to continuously adapt their business strategies. Their findings highlight the importance of e-business strategies that align technological investments with organizational objectives. Similarly, Vargas and Comuzzi (2019) demonstrate that Enterprise Information Systems operate through a multidimensional framework in which e-commerce reshapes business relationships while ICT enhances service delivery and operational efficiency.

Enterprise Information Systems (EIS)

Enterprise Information Systems (EIS), including Enterprise Resource Planning (ERP) systems, are designed to support and integrate various organizational functions such as finance, accounting, human resource management, procurement, and operations. Ali and Miller (2017) found that integrated information systems play a critical role in managing organizational processes and improving overall business performance. This perspective is

reinforced by Xie, Allen, and Ali (2022), who argue that integrating organizational processes and data into a unified platform creates robust and efficient systems that enhance software operations and decision-making processes. Such integration enables organizations to streamline workflows, reduce redundancies, and improve access to accurate and timely information.

The successful adoption of EIS depends largely on understanding the business environment and customer needs. Nicolaou and Bhattacharya (2006) note that ERP usage positively affects organizational performance by facilitating the integration of emerging technologies such as Business Intelligence and Analytics (BI&A) within enterprise systems. Furthermore, Kuranga, Maslin, and Maarop (2021) identify several critical success factors for cloud ERP implementation, emphasizing the importance of addressing knowledge gaps and understanding the frameworks that support information system adoption across various economic sectors.

Importance of EIS and Its Components

Enterprise Information Systems are increasingly recognized as essential tools for integrating diverse business processes into a unified operational framework. Solano and Cruz (2024) describe EIS as a critical enabler of organizational efficiency through the integration of analytics and enterprise-wide information management. Unlike traditional management tools, ERP systems provide comprehensive solutions that span multiple functional areas within an organization. Salih et al. (2022) argue that ERP systems support structured business environments by placing information management at the center of organizational activities. Likewise, Mullins and Cronan (2021) emphasize that integrating ERP systems with Business Intelligence and Analytics (BI&A) significantly enhances organizational performance and decision-making capabilities.

Despite their strategic value, the implementation and utilization of EIS face numerous challenges. Studies by Khan et al. (2022) and Ayat et al. (2020) identify issues such as inadequate organizational maturity, security vulnerabilities, and underutilization of systems, which limit the effectiveness of information technology in business process integration. Similarly, Maas, Van Fenema, and Soeters (2018), together with Mahmood, Khan, and Bokhari (2019), highlight post-implementation challenges and demonstrate how organizations increasingly rely on business intelligence systems to meet evolving market demands.

Research by Alkrajji et al. (2020) and Amado and Belfo (2021) further reveals that organizational size and industry characteristics significantly influence technology adoption rates. However, many organizations continue to underutilize available technologies, creating a gap between technological advancements and effective organizational integration. Barth and Koch (2019), Anno and Ameripus (2022) as well as Damagala et al. (2012), identify executive support, user training, and effective integration with existing systems as critical success factors for successful technology implementation.

Governance of Corporations

Enterprise Information Systems are transforming corporate governance by facilitating a shift from traditional internal processes toward more open and integrated business interactions. These systems support resource management, procurement,

marketing, and other complex organizational functions through centralized information sharing and decision support mechanisms. ERP systems, in particular, strengthen financial and operational oversight by promoting transparency, improving decision-making, and facilitating efficient data exchange across departments. Emerging trends include the automation of ERP functions, the adoption of open technologies, and the implementation of service-oriented architectures. The growth of e-commerce has further increased the importance of business-to-business (B2B) interactions within EIS environments, leading to greater integration between ERP systems and e-commerce platforms. The adoption of Software as a Service (SaaS) models has also accelerated innovation and enhanced system accessibility.

Kirmizi and Kocaoglu (2021) emphasize that successful EIS deployment requires active user involvement and effective management of implementation challenges. Additionally, Ghazaleh, Abdallah, and Zabadi (2019) stress the importance of security considerations, given that EIS integrates large volumes of sensitive organizational data. Effective security policies, employee training, and access control mechanisms are essential for protecting organizational information, particularly because human error remains a significant source of security risk (Buanawati et al., 2019). Furthermore, Coşkun et al. (2022) and Amado and Belfo (2021) note that rapid technological advancements and globalization have increased the complexity of IT governance. Nevertheless, organizations that effectively leverage advanced information technologies can achieve significant competitive advantages through enhanced efficiency, communication, and managerial effectiveness.

Organizational Strategy and Competitive Advantage

The relationship between information systems and organizational strategy has been widely explored in the literature. Several studies emphasize that organizations must align their business activities with information system capabilities to achieve sustainable competitive advantages (Barth & Koch, 2019). Organizations operate in increasingly complex environments characterized by globalization, technological change, ethical considerations, and information overload. Malik and Khan (2020) argue that developing a competitive strategy requires a comprehensive understanding of both organizational capabilities and competitor activities, which in turn necessitates adaptable and responsive information systems.

Information technology contributes to organizational performance by improving data management, supporting strategic alliances, facilitating e-commerce, and enhancing customer relationship management (CRM). Best practices such as self-service technologies, continuous process improvement, and business process reengineering further strengthen organizational competitiveness. Anno, Pjero and Lotiang (2022) and Salih et al. (2022) also highlight the importance of considering economic, technological, and ethical factors to ensure successful IT integration and regulatory compliance. Ultimately, information technology serves as a powerful enabler of communication, innovation, and competition. By effectively leveraging information systems, even small and medium-sized enterprises can compete successfully in global markets through superior service delivery and efficient business operations rather than relying solely on advanced technical expertise.

Methodology

The application of technology to integrate livestock production and marketing activities in Turkana County remains an emerging area of research and development. While most secondary livestock markets are equipped with modern selling yards and administrative offices, the technological infrastructure required to support efficient market operations is largely absent. To investigate this gap, the study adopted an exploratory research design and employed a mixed-methods approach to comprehensively examine the influence of technology on the integration of livestock production and marketing systems. This approach enabled both broad analysis and in-depth exploration of the underlying processes and interactions.

The study was conducted in eight livestock markets across Turkana County, comprising both primary and secondary markets. The primary markets included Kerio, Kalokol, Lokichoggio, Lorugum, and Katilu, while the secondary markets were Kakuma, Lodwar, and Lokichar. Data were collected from members of the livestock market management committees and through eight Focus Group Discussions (FGDs) involving a total of 80 participants, of whom 32% were women. The FGDs provided valuable insights into market operations, technology adoption, and stakeholder experiences across the livestock value chain.

Both quantitative and qualitative methods were used to analyse the data. A comprehensive literature review was undertaken to provide foundational knowledge on Enterprise Information Systems (EIS) and their major components, including Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), Supply Chain Management (SCM), Human Resource Management Systems (HRMS), and Business Intelligence (BI) systems. The findings were further validated through consultations and discussions with livestock traders, government officials, civil society representatives, researchers, and scholars involved in livestock development, thereby enhancing the credibility and reliability of the study results.

Results and Discussion

Implications of the Absence of an Enterprise Information System in a Livestock System

The study established that the livestock sector in Turkana County operates with minimal technology-driven production and marketing systems, with limited utilization of Information and Communication Technology (ICT) and Information Technology (IT). Consequently, livestock farming and marketing activities lack integrated mechanisms for managing critical information related to animal tracking, sales, inventory, finance, transportation, and customer relations. Findings revealed significant weaknesses in data management across livestock markets. Records are often maintained manually or in isolated systems, resulting in inaccuracies, duplication, and loss of information. The absence of centralized and real-time data limits access to essential information on livestock traceability, pricing, sales performance, and market trends, thereby constraining informed decision-making.

The study further identified inadequate traceability mechanisms within livestock markets, making compliance with animal health and food safety regulations difficult. Reliance on manual processes increases operational costs through higher labor requirements and exposes stakeholders to financial losses arising from inventory discrepancies and transaction errors. Poor

coordination and communication among farmers, traders, transporters, veterinarians, and other actors contribute to delays, inefficiencies, and misunderstandings throughout the livestock value chain. Customer service is also negatively affected due to the absence of systems for managing buyer information and transaction histories. This results in slower responses to customer inquiries, complaints, and market demands. Furthermore, ineffective livestock inventory management leads to overstocking, shortages, and unaccounted livestock, reducing market transparency and weakening trust among market participants.

The lack of transparency contributes to unfair pricing practices, limiting the bargaining power of producers and traders. Financial management is similarly constrained due to fragmented revenue and expenditure tracking systems, resulting in delayed reporting and inaccurate financial records. As livestock markets continue to grow, manual systems become increasingly inefficient, hindering scalability and limiting opportunities for market expansion.

Applications of Enterprise Information Systems in Livestock Production

Livestock production in Turkana County remains largely traditional, characterized by open grazing, nomadic pastoralism, traditional animal healthcare practices, and barter-based trading systems. The study identified major inefficiencies associated with inadequate animal identification and record-keeping systems. The absence of integrated information systems limits the ability to track individual animals, monitor health status, and maintain comprehensive production records. Animal health and disease management are significantly affected by the lack of digital monitoring systems. Farmers face challenges in tracking vaccinations, disease outbreaks, treatment records, and compliance with veterinary regulations. As a result, disease surveillance and control measures are often ineffective.

The findings further indicate limited adoption of technologies for feed formulation, feed inventory management, and nutritional monitoring. This restricts the ability of pastoralists to formulate balanced diets, evaluate feed efficiency, and minimize wastage. Although livestock keepers rely heavily on natural grazing resources to maintain productivity, inadequate market incentives discourage investment in advanced nutritional management practices. Similarly, the absence of technological solutions for monitoring breeding cycles, artificial insemination programs, reproductive performance, and genetic improvement undermines breeding management. This limits opportunities for genetic selection, reproductive efficiency, and disease diagnosis.

The study also found that key production outputs including live weight, meat yield, milk production, growth rates, hides and skins quality, and overall animal productivity are inadequately monitored. The absence of production monitoring systems prevents the generation of performance reports for individual animals and herds, making it difficult to identify high-performing and low-performing livestock. Inventory and resource management remain largely manual, resulting in inconsistent tracking of feed stocks, veterinary drugs, equipment, and other production inputs. Without automated replenishment mechanisms and accurate utilization records, resource wastage and losses are common.

Financial management presents additional challenges due to poor record-keeping of production costs, revenues, and profitability. The lack of integrated financial systems limits

budgeting, planning, and investment decisions. Moreover, supply chain and marketing management are constrained by inadequate technologies for product tracking, order management, and food safety compliance. Consequently, pastoral livestock systems lack the analytical reports, dashboards, and decision-support tools necessary for strategic planning and risk management.

Regulatory Compliance and Reporting Systems can facilitate the maintenance of records required by government agencies and industry regulators, supporting reporting on animal welfare, environmental sustainability, and food safety standards. Furthermore, Environmental Information Systems (EIS) offer substantial benefits, including improved animal health, enhanced productivity, better traceability, reduced operational costs, and improved decision-making. However, traditional livestock production systems face increasing pressure to meet evolving consumer preferences and regulatory requirements, highlighting the need for technological innovation and modernization.

Enterprise Information System Tools for Livestock Production

The study identified several Enterprise Information System tools that can significantly enhance livestock production efficiency. Livestock Management Information Systems (LMIS) enable farmers to monitor animal health, breeding, feeding practices, and productivity. Commonly used platforms include CattleMax, Herdwatch, and AgriWebb, which support animal identification, breeding management, health monitoring, and growth tracking. Enterprise Resource Planning (ERP) systems, including SAP ERP, Oracle NetSuite, and Microsoft Dynamics 365, facilitate the integration of critical business functions such as finance, inventory management, procurement, and operational planning. These systems provide a centralized platform for managing livestock production activities.

Geographic Information Systems (GIS), such as ArcGIS and QGIS, support land and pasture management through mapping grazing areas, monitoring pasture conditions, tracking water resources, and supporting land-use planning. Decision Support Systems (DSS) further enhance farm management by analyzing production data and generating recommendations related to feed optimization, disease prediction, breeding strategies, and production forecasting. The study also highlighted the importance of sensor technologies and Internet of Things (IoT) devices in modern livestock production. Technologies such as Electronic Identification (EID) tags, GPS collars, smart feeding systems, and environmental sensors provide real-time data that supports efficient livestock management.

Database Management Systems (DBMS), including MySQL and PostgreSQL, offer robust platforms for storing, managing, retrieving, and analyzing livestock records. In addition, Business Intelligence (BI) tools such as Microsoft Power BI and Tableau transform farm data into actionable insights through dashboards, trend analyses, cost tracking, and performance reporting. Collectively, these technologies contribute to improved productivity, profitability, animal welfare, traceability, compliance, resource utilization, and evidence-based decision-making in livestock production systems.

Enterprise Information System Tools for Livestock Marketing

Enterprise Information Systems (EIS) play a critical role in livestock marketing by enabling stakeholders including farmers, traders, cooperatives, processors, and policymakers to collect,

manage, analyze, and share market information effectively. The study identified Livestock Market Information Systems (LMIS) as essential tools for providing real-time information on livestock prices, market demand and supply trends, transaction volumes, and market locations. Platforms such as e-Soko and the FAO Livestock Market Information System improve price transparency, reduce information asymmetry, and empower farmers to make informed marketing decisions.

Enterprise Resource Planning (ERP) systems, including SAP ERP and Oracle NetSuite, streamline livestock marketing operations by integrating inventory management, sales processes, procurement activities, and financial accounting. These systems enhance organizational efficiency and support data-driven decision-making. Customer Relationship Management (CRM) systems such as Salesforce and Zoho CRM strengthen customer engagement by facilitating the management of customer interactions, marketing campaigns, and after-sales services. Improved customer relationship management contributes to higher customer satisfaction and retention. Geographic Information Systems (GIS), including ArcGIS and QGIS, support livestock marketing through spatial analysis of grazing areas, livestock movements, disease outbreaks, transportation networks, and market accessibility. These capabilities enhance planning, disease surveillance, and market connectivity.

The study also identified mobile-based marketing platforms such as M-Farm and DigiCow as important innovations that connect livestock sellers directly with buyers. These platforms facilitate mobile payments, improve access to market information, and reduce dependence on intermediaries. Decision Support Systems (DSS) further contribute to livestock marketing by analyzing market data and providing recommendations on pricing strategies, market entry timing, production planning, and risk management. Through these capabilities, DSS enhance strategic decision-making and profitability.

Overall, the adoption of Enterprise Information Systems in livestock marketing can improve market efficiency, increase access to information, support fair pricing, reduce transaction costs, strengthen traceability and quality assurance, and enhance the competitiveness of livestock enterprises. These technologies have the potential to transform pastoral livestock production and marketing systems, enabling them to meet the demands of modern markets while improving the livelihoods of pastoral communities.

EIS requirements for Livestock production and Marketing in Turkana

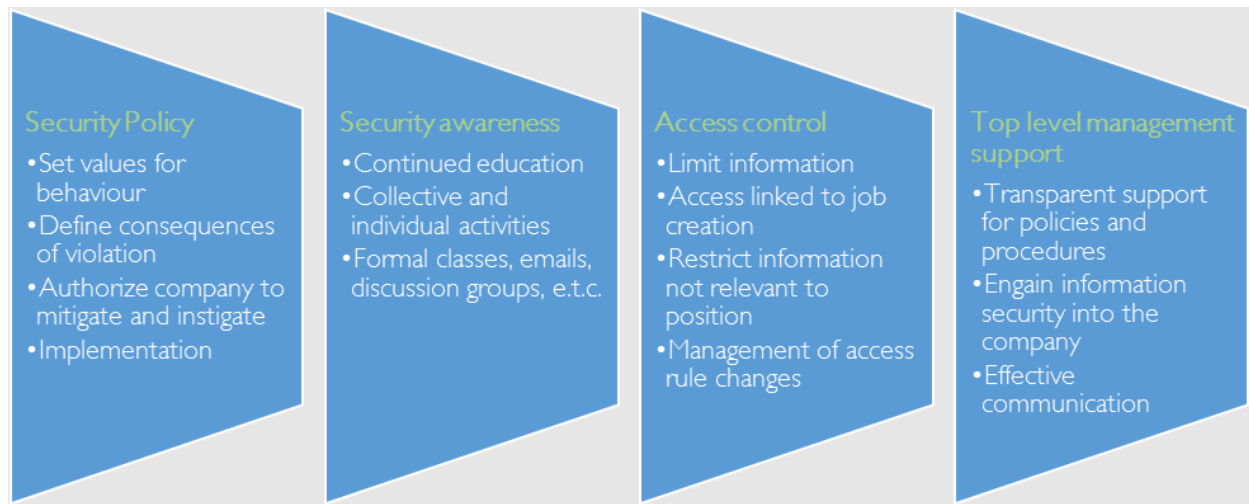
In Turkana County, the study proposes a framework using ICT and industry software to enhance the integration of livestock production and marketing. Centralized coordination by the Turkana County Livestock Marketing Council will facilitate data-driven decision-making for operational efficiency in these sectors.

Table 1: Technological requirements of EIS

Technology requirements	Application and benefits
Hardware	All centrally organized markets, such as the Turkana County Livestock Marketing Council (TCLMC), necessitate servers, computers, mobile devices, storage systems, and networking equipment to support the physical infrastructure of livestock production and marketing systems.
Software	Integration of systems such as ERP and CRM with livestock production and marketing enhances data processing, analysis, and overall business operations.
Data	Data is a key organizational asset, necessitating that livestock production and marketing records including customer records, staff data, financial data, inventory information, and transaction records be maintained both physically and electronically in all market jurisdictions.
People	Identification and equipping of personnel including end users, managers, IT specialists, system administrators, and stakeholders is crucial for effective information integration in livestock development initiatives.
Procedures and Processes	To ensure consistency and efficiency, it is essential that rules, policies, workflows, and business procedures for system use are well-formulated and approved by the appropriate livestock production and marketing focal points in the county.
Networks and Telecommunications	To facilitate data exchange and connectivity across departments and locations, various networks such as Internet, intranet, cloud services can be established and integrated with the TCLMC server.
Database Management Systems (DBMS)	County livestock production and marketing departments, along with TCLMC, need to acquire technologies for the effective storage, organization, retrieval, and management of livestock enterprise data to ensure integrity, security, and accessibility.
Security Controls	To protect data and organizational systems from threats, it is essential to implement procedures like authentication, authorization, encryption, backups, and disaster recovery.

The protocol below can facilitate security controls in the EIS to be established in Turkana livestock system.

Figure 1: EIS Security protocol



Enterprise Information System Framework for livestock marketing in Turkana

Management Support

Enterprise Information System (EIS)

The Enterprise Information System (EIS) should provide a user-friendly interface featuring intuitive dashboards that enable executives to access critical information quickly and efficiently. The system must integrate data from multiple sources and support the simultaneous organization of both internal and external information. To support strategic decision-making, the EIS should include advanced analytical tools for forecasting, trend analysis, and strategic planning. It must deliver essential reports, alerts, performance summaries, and key business insights in a clear and timely manner.

The system should also incorporate exception reporting capabilities, allowing management to identify and respond to unusual events or performance deviations promptly. Furthermore, the EIS should enhance communication and collaboration across departments through integrated collaboration tools and video conferencing features. It should maintain comprehensive information on market trends, economic indicators, and competitor activities while ensuring the protection of sensitive organizational data through robust access control and security measures.

Decision Support System (DSS)

The Decision Support System (DSS) should leverage data management and storage technologies, including databases and data warehouses, to improve the efficiency and quality of organizational decision-making. The system must support the

collection, storage, and retrieval of relevant data for analysis. A variety of mathematical, statistical, and analytical models should be incorporated to facilitate scenario analysis and evaluate alternative courses of action. The DSS must also provide access to current organizational knowledge, business processes, and relevant information to support informed decisions.

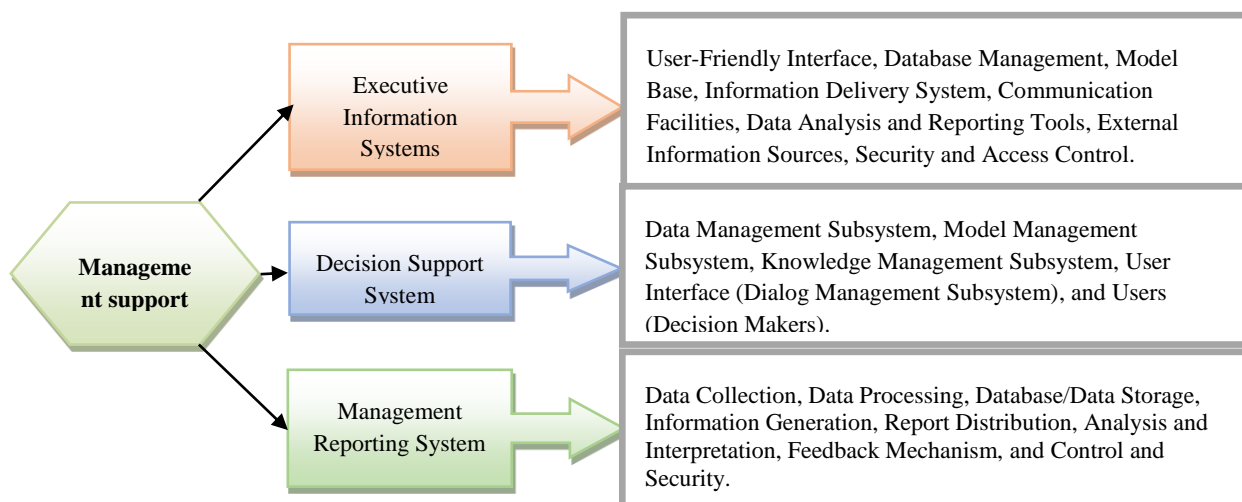
To ensure usability, the system should offer user-friendly interfaces such as dashboards, menus, and interactive reporting tools. These features will enable managers and stakeholders to easily access, analyze, and interpret information, thereby supporting effective and evidence-based decision-making.

Management Reporting System (MRS)

The Management Reporting System (MRS) should collect, process, and organize data from both internal and external sources, including sales records, operational data, and customer feedback. This information should be transformed into meaningful reports, performance indicators, and business insights that align with management requirements. The system should function as a secure central repository, allowing authorized users to access, evaluate, and utilize information efficiently. Reports must be delivered in a timely manner through dashboards, management portals, and email notifications, enabling managers to identify trends, recognize opportunities, and make informed decisions.

Additionally, the MRS should support continuous improvement through feedback mechanisms that allow managers to recommend updates and enhancements. Strong security controls must be implemented to ensure data accuracy, integrity, confidentiality, and compliance with organizational policies.

Figure 2: EIS Management Support Framework



Support of Work Knowledge

Professional Support Systems

Professional support systems provide a structured framework that assists management in decision-making, performance evaluation, and employee development. These systems facilitate coaching and skill acquisition while promoting collaboration, emotional support, training opportunities, and continuous mentorship within the livestock industry.

Employees benefit from participation in professional associations and networking opportunities, which provide access to industry knowledge, emerging technologies, and valuable resources. The framework also incorporates employee assistance initiatives that promote well-being, work-life balance, and a positive workplace culture. Furthermore, the sharing of information, recognition of achievements, and encouragement of teamwork foster innovation and continuous improvement. Successful implementation of professional support systems relies on ethical practices, clearly defined processes, and an inclusive work environment.

Collaboration Systems

Collaboration systems involve individuals and organizations engaged in livestock farming working together toward common objectives. Each stakeholder has clearly defined roles and responsibilities that contribute to efficient task execution and organizational success. Effective communication is essential for coordination and may occur through synchronous channels, such as meetings and phone calls, or asynchronous channels, such as emails and message boards. Collaboration systems improve operational efficiency by streamlining workflows, schedules,

resource allocation, and task management. They also support project oversight and accountability.

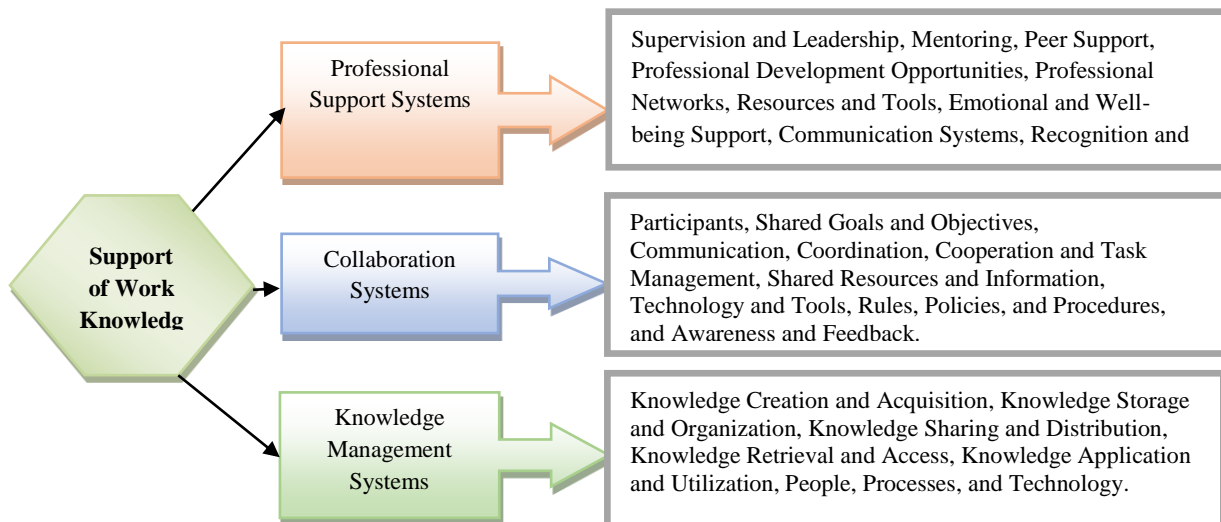
The adoption of collaboration software, including Microsoft Teams and Slack, has enhanced communication and project management capabilities within organizations. In the livestock farming sector, these technologies improve employee productivity, strengthen coordination, and increase awareness of operational activities, ultimately contributing to better organizational performance.

Knowledge Management Systems

Knowledge management systems support the creation, storage, organization, and dissemination of information generated through research, innovation, and practical experience. Knowledge is systematically stored in databases and repositories, where it can be easily accessed and utilized by stakeholders. These systems employ categories, tags, and metadata to facilitate efficient organization and retrieval of information. Tools such as intranets, knowledge repositories, and collaborative platforms enhance knowledge sharing across the organization. User-friendly search functions further enable quick access to relevant information when needed.

In livestock organizations, effective knowledge management contributes significantly to informed decision-making, operational efficiency, and overall organizational performance. The successful management of knowledge depends on a collaborative organizational culture, established protocols, and the effective use of technology, supported by personnel with the necessary expertise in software applications and digital tools.

Figure 3: EIS Support of Work Knowledge Framework



Operational Support

Supply Chain Management (SCM)

Supply Chain Management (SCM) enhances production scheduling and ensures the availability of resources required for operations. It establishes supply chain objectives, identifies suitable vendors, and facilitates the purchasing process. SCM enables industry participants to efficiently manage supply systems and maintain quality assurance while optimizing stock levels to ensure smooth and timely movement of goods. It also supports inventory tracking, order management, and timely delivery through technologies such as Enterprise Resource Planning (ERP) systems and Radio Frequency Identification (RFID). In addition, SCM frameworks extend to after-sales processes, including recycling, repairs, and warranty services, ensuring the entire product lifecycle is effectively managed.

Customer Relationship Management (CRM)

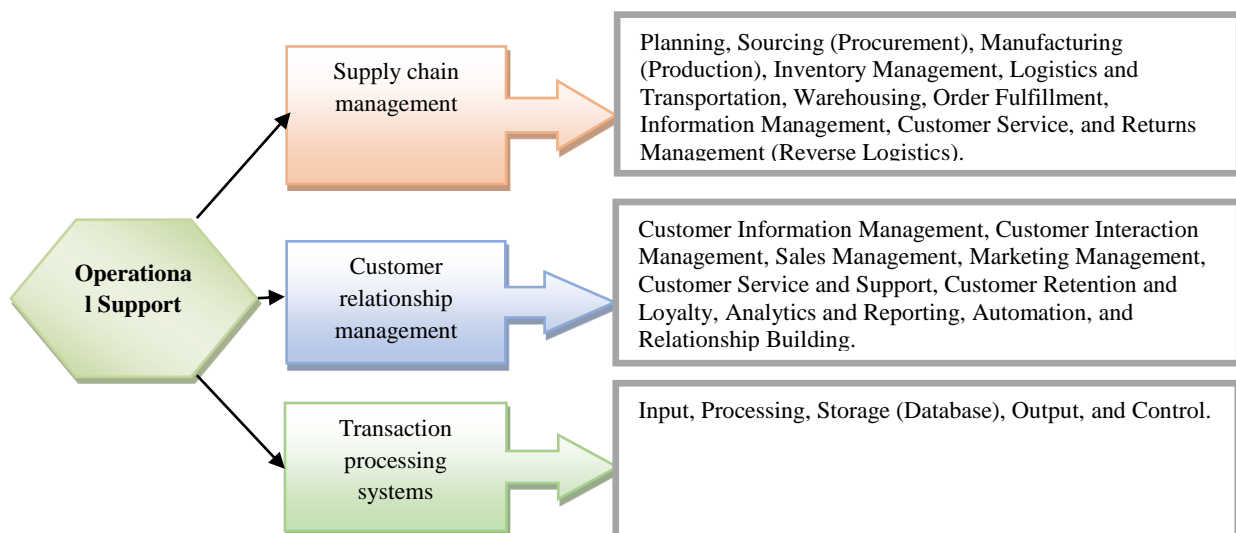
Customer Relationship Management (CRM) focuses on the collection, storage, and integration of customer information into a centralized database. This enables improved communication across multiple channels and supports personalized customer interactions. CRM systems assist businesses in tracking sales activities and

developing targeted marketing strategies. In livestock businesses, for example, CRM can be used to segment customers, evaluate marketing effectiveness, and respond efficiently to customer inquiries, thereby improving overall satisfaction. Furthermore, CRM leverages data analytics to enhance customer retention and loyalty programs by identifying trends and automating routine tasks. This improves operational efficiency while fostering long-term customer relationships and business growth.

Transaction Processing Systems (TPS)

Transaction Processing Systems (TPS) are designed to collect and process transactional data from user-generated documents such as sales orders, payment details, and attendance records. These systems perform essential functions including calculations, sorting, categorization, validation, and updating of records. All transaction data is stored for future use in databases such as customer records, inventory files, and sales systems. TPS also generates important business documents such as invoices, receipts, payroll reports, and account statements. To ensure reliability, accuracy, and security, these systems implement measures such as user authentication, error detection, data backup, and audit trails.

Figure 4: EIS Operational Support Framework



Conclusion

The study concludes that without an enterprise information system, Turkana's livestock production and marketing faces technological deficiencies that hinder effective data management and decision-making. The existing manual tracking leads to inaccuracies and operational inefficiencies, complicating compliance with health regulations and inflating costs due to labor-intensive processes. Poor communication among stakeholders delays transactions and diminishes customer service, while the lack of market transparency undermines trust and compromises pricing strategies. Traditional farming practices and inadequate technology cause challenges in animal health management, inventory, and financial planning, restricting growth and compliance with modern standards.

The integration of enterprise information systems, such as Livestock Management Information Systems and Geographic Information Systems, is crucial for enhancing efficiency in livestock production and marketing by providing real-time data, improving traceability, and facilitating strategic planning. Tools like e-Soko and mobile-based platforms can empower farmers by maximizing market access and reducing exploitation. Overall, technological adoption is essential for the sustainable development of Turkana's livestock sector.

Security controls are critical for safeguarding data and systems against threats, emphasizing procedures like authentication, authorization, encryption, backups, and disaster recovery. The proposed Enterprise Information System Framework for livestock marketing in Turkana includes user-friendly dashboards, data integration, analytical tools for decision-making, and security measures for sensitive data. The Decision Support System (DSS) enhances efficiency through data management technologies and user interfaces, while the Management Reporting System provides timely reports for informed decisions. Professional Support Systems aim to improve management through training and collaboration, and Collaboration Systems enhance communication among stakeholders. Additionally, Supply Chain Management (SCM) optimizes resources and ensures efficient logistics, while Customer Relationship Management (CRM) consolidates customer data for better interaction and marketing strategies. Finally, Transaction Processing Systems reliably gather and manage transactional data, ensuring security and accuracy through various checks and backups.

Recommendations for Application

Based on the findings and conclusions of the study, the following are proposals for enhancing livestock production and marketing in Turkana through technological integration:

Put an Enterprise Information System (EIS) in place

Turkana County needs to implement a holistic enterprise information system for the automation of livestock marketing to improve data management and facilitate evidence-based decision-making. The system should incorporate information on livestock production, marketing, financial and regulatory issues in one platform.

Introduce Livestock Management Information Systems (LMIS)

A system for managing livestock information should be introduced to monitor animal health, inventory, breeding records, and market activity in real time. This will increase traceability,

disease control, and compliance with livestock health requirements.

Utilisation of Geographic Information Systems (GIS)

GIS technology should be used in livestock management for resource mapping, grazing, disease surveillance and strategic planning. This will allow stakeholders to make informed decisions based on geographic and environmental data.

Encourage Mobile-Based Market Information Platforms

The county government and development partners should promote platforms, such as e-Soko and other mobile applications, that provide farmers with real-time market prices, buyer information, and trading opportunities. This will eliminate knowledge asymmetry and safeguard farmers from exploitation by middlemen.

Enhance Data Security and Risk Management

Implement strong security measures, such as user authentication and authorisation procedures, data encryption for sensitive data, regular system backups, disaster recovery, and business continuity planning, as well as regular security audits and monitoring. These steps will safeguard the confidentiality, integrity and availability of livestock production and marketing data.

Decision Support Systems (DSS) Development

A decision support system should be embedded in the EIS, providing analytical tools, forecasting capabilities, and performance dashboards. This will help improve strategy planning, resource allocation and policy making.

Improve Management Reporting Functionality

Livestock marketing organisations should have management reporting systems in place to provide timely, accurate, and comprehensive information that supports operational and strategic decision-making.

Foster Stakeholder Collaboration and Communication

Establish collaboration platforms to facilitate seamless communication among farmers, traders, veterinary officers, transporters, financial institutions, and government organisations. Better communication would reduce delays in transactions and improve the delivery of services.

Implement a Supply Chain Management (SCM) Solution

It is essential to implement supply chain management systems to optimise the flow of livestock logistics, inventory management, and resource utilisation. This will cut operational expenses and increase market efficiency.

CRM (Customer Relationship Management) Systems

CRM systems are to be implemented for the consolidation of customer information, the improvement of customer interaction, the strengthening of marketing activities, and the enhancement of buyer-seller connections.

Automate Transaction Processing

Transaction processing systems should be installed to accurately record sales, purchases, payments and inventory movements. Automation will reduce errors, increase openness, and increase responsibility.

Develop capacity by providing professional support and training

Continuous training programmes should be provided to the farmers, traders and county officials on: Digital literacy, enterprise information systems usage, data-driven decision-making, Training should also cover livestock health and traceability management, as well as cybersecurity awareness. This process ensures the successful implementation and sustainability of the proposed technologies.

Enhance Market Transparency

The proposed EIS should enable transparent access to market data, including livestock prices, demand patterns and transaction records. Such transparency will establish trust among stakeholders and help underpin fair pricing arrangements.

Develop supportive policies and infrastructure

The county government should invest in IT infrastructure, internet access and supportive policies that promote digital transformation in the livestock industry. Use public-private partnerships to mobilise resources for the installation and maintenance of technologies.

Promote Phased Implementation and Ongoing Evaluation

The proposed system will be implemented in phases, starting with the fundamental tasks of livestock registration, market information distribution, and transaction processing. Performance should be assessed, and areas for improvement should be identified through regular monitoring and review.

Disclaimer

- The views stated in this article are those of the author and do not necessarily represent those of any of the entities mentioned.

Interest Conflicts

- The author declares no conflict of interest whatsoever in this publication.

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