Literature review on dairy cow rearing in sub-Saharan Africa

Abstract :

This literature review on dairy cattle rearing in sub-Saharan Africa aims to provide an in-depth analysis of the current situation of this activity in the region. It examines the various dimensions of dairy farming, such as its economic importance, its impact on food security and its role in poverty reduction. The review also looks at existing farming systems, factors influencing dairy cow productivity, constraints and challenges faced by farmers, good practices and innovations, environmental impacts, and policies and programmes to support dairy cow farming. The aim of this review is to provide valuable information for improving this activity in the region.

Keywords: dairy cows, sub-Saharan Africa, farming practices, constraints and challenges

1. Introduction

Dairy farming in sub-Saharan Africa plays an essential role in the region's agricultural and food economy. The sector is of paramount importance to farmers and rural communities, providing livelihoods and contributing to local and national economies. The dairy sector contributes significantly to food security and job creation in rural areas. FAO (2021). This literature review aims to bring together existing knowledge on dairy farming in the region in order to better understand farming practices, the challenges faced by farmers and possible solutions to improve the productivity and profitability of this sector.

1.1. Objective of the literature review

The aim of this literature review is to synthesise the available information on dairy farming in sub-Saharan Africa, analyse the various issues related to this farming and highlight the opportunities and challenges. The review also aims to identify gaps in current knowledge and to propose recommendations for future research and interventions in the field of dairy farming.

1.2. Methodology

To carry out this literature review, we used a method based on an in-depth search for relevant sources. We consulted specialised books, scientific articles, government reports, case studies and academic databases in order to gather accurate and reliable information on dairy farming in sub-Saharan Africa. We critically analysed these sources and selected the most relevant and up-to-date information for inclusion in this review. The research methodology used has enabled us to obtain a comprehensive overview of the dairy farming situation in the region.

2. Economic and social importance of dairy farming

Dairy farming is a major industry in sub-Saharan Africa, making a significant contribution to the local economy. It is a major source of income for many households, particularly in rural areas. As well as providing milk for consumption and sale on local markets, dairy cow farming also provides direct and indirect employment, thereby promoting the economic development of local communities.

2.1. Contribution to the local and national economy

Dairy farming makes a significant contribution to the gross domestic product (GDP) of sub-Saharan African countries. In countries such as Kenya, Ethiopia and Uganda, for example, the dairy sector represents a substantial portion of the agricultural economy. According to FAO estimates, milk production can account for as much as 4-8% of agricultural GDP in some of these countries.(Staal, Pratt, and Jabbar, 2008).

2.2. Job creation and income generation

The dairy sector is a major source of income and employment for rural populations. It provides direct employment opportunities for dairy farmers and indirect employment opportunities for those involved in value chains, including the transport, processing and

Comment [KA1]: Introduction

Issues:

1. **Citation Style**: The reference to FAO (2021) is incomplete. It should be integrated more seamlessly into the text.
2. **Repetition**: The role of the dairy sector in food security and job creation is mentioned twice.
3. **Clarity**: The sentence structure can be more concise.

Suggestions:

- Combine the repeated ideas into a single, clear statement.
- Ensure proper citation by providing full references at the end of the article.

Revised Section: "Dairy farming in sub-Saharan Africa plays a crucial role in the region's agricultural and food economy, providing livelihoods and significantly contributing to both local and national economies. This sector is vital for food security and job creation in rural areas (FAO, 2021). This literature review aims to consolidate existing knowledge on dairy farming in the region, better understand farming practices, identify challenges faced by farmers, and explore potential solutions to enhance the productivity and profitability of this sector."

Objective of the Literature Review

Issues:

- Minor repetition in stating the aims.

... [1]

Comment [KA2]: Issues:

- Passive voice usage could be made more active for clarity.

Suggestions:

- Use active voice to describe the methodology.

Revised Section: "We conducted an in-depth search for relevant sources, consulting specialized books, scientific articles, government reports, case studies, and academic databases to gather accurate and reliable information on dairy farming in sub-Saharan Africa. We critically analyzed these sources and selected the most relevant and up-to-date information for this review, providing a comprehensive overview of the region's dairy farming situation."

Economic and Social Importance of Dairy Farming

Issues:

- Section headings need to be consistent in style.
- Some data needs to be updated or verified for accuracy.

Suggestions:

- Ensure consistency in headings and subheadings.
- Verify all data and update where necessary.

Revised Section: "Dairy farming significantly contributes to the local economy in sub-

... [2]

marketing of milk. For example, according to the study by Otte and Upton (2005), around 1.6 million households in Tanzania depend on dairy production for their livelihoods.

2.3.Multiplier effects on the economy

The benefits of dairy farming have a considerable impact on the local economy. The rural economy is often stimulated by milk-producing households using their income to purchase local goods and services. Research in Kenya found that profits from milk are frequently reused to educate children, improve housing and purchase other livestock (Wambugu, Kirimi, and Opiyo, 2011).

2.4.Income diversification and risk reduction

Dairy farming also makes it possible to diversify the sources of income of farming households, thereby reducing their vulnerability to economic and climatic shocks. By diversifying their economic activities, farmers are able to better manage the risks associated with crop price fluctuations and adverse weather conditions. (Thornton and Herrero, 2010).

2.5.Development of rural infrastructure

Rural infrastructure is often improved by the development of the dairy sector. Transporting fresh milk to urban markets, for example, can encourage the creation and maintenance of rural roads. According to Duteurtre and Corniaux (2013), milk collection centres and processing units play a role in improving local infrastructure.

3. Impact on food security and poverty reduction

Dairy farming plays a crucial role in the local economy in sub-Saharan Africa. It contributes not only to job creation, but also to income generation.

3.1.Improving food safety

Dairy farming contributes directly to the food security of rural households by providing a regular source of dairy products, which are rich in proteins, vitamins and essential minerals. Consumption of milk and dairy products helps to improve nutrition, particularly in children, which is crucial for physical and cognitive development. According to Staal, Pratt, and Jabbar (2008), in many sub-Saharan African countries, dairy products form a significant part of the diet of rural households. In Kenya, milk is an important source of nutrition for children and adults, contributing to household food security.

3.2.Generating stable income

Farm households benefit from a stable source of income through the sale of milk and dairy products. This income enables families to purchase other foods, thus diversifying their diet and improving overall food security. According to Otte and Upton (2005), in Uganda, milk production enables households to earn a steady income throughout the year, even during periods of drought when crops may fail.

3.3.Poverty reduction

Dairy farming plays a crucial role in reducing poverty by offering economic opportunities to poor households. Income generated from the sale of milk can be used to improve living conditions, access education and healthcare, and invest in other economic activities. Kristjanson et al (2010) have shown that households that own livestock, including dairy cows, often have a higher standard of living and are less likely to live in extreme poverty. According to Thornton and Herrero (2010), households involved in dairy production in Tanzania have been able to improve their living conditions thanks to the income generated by the sale of milk.

3.4.Empowering women

Dairy farming also has a positive impact on women's empowerment. In many countries in sub-Saharan Africa, women play a central role in managing dairy cows and selling milk. This activity enables them to generate income and strengthen their socio-economic position within the community. Njarui et al (2011) found that women involved in dairy production in Uganda and Kenya were able to access financial resources and improve their participation in family and community decision-making. This empowerment contributes not only to poverty reduction, but also to improved food security.

3.5.Strengthening local food systems

Dairy farming helps to strengthen local food systems by creating links between producers, processors and consumers. Local dairy products are often more accessible and affordable for rural communities, improving food security. Duteurtre and Corniaux (2013) have shown that in certain regions of West Africa, local dairy systems play a crucial role in supplying local markets with fresh dairy products. These systems support not only food security, but also the local economy by creating jobs and stimulating economic activities.

4. Existing dairy farming systems in sub-Saharan Africa

Dairy farming systems in sub-Saharan Africa vary according to available resources and traditional practices.

4.1.Extensive farming systems

Extensive dairy farming in sub-Saharan Africa is widely practised in areas with abundant grazing resources. In this system, the cows are reared freely and feed mainly on grass and wild plants. The animals often have limited access to concentrated feed, which affects their milk productivity. Extensive livestock farming can be a viable option in areas where grazing land is extensive and farmers have limited means of purchasing feed. Nomadic or semi-nomadic pastoralists, such as the Maasai in Tanzania and Kenya, practise extensive livestock farming using large tracts of land for grazing (Duteurtre and Corniaux, 2013). These systems rely on the mobility of herds to access pasture and watering points, which helps to maintain livestock productivity despite difficult climatic conditions.

4.2.Semi-intensive farming systems

Semi-intensive livestock farming systems are generally practised in peri-urban and rural areas of regions with moderate rainfall. These systems combine traditional husbandry techniques with modern practices to improve productivity. Cattle are often kept in paddocks and fed a combination of natural pastures, fodder crops and feed supplements. In Uganda, for example, small-scale dairy farmers use semi-intensive systems to increase milk production while reducing production costs (Moll and Kaganzi, 2008). These systems also enable better management of natural resources and a reduction in the environmental impact of livestock farming.

4.3.Intensive farming systems

Intensive farming systems are less common in sub-Saharan Africa because of the high costs and infrastructure requirements, but they do exist in some urban and peri-urban areas where demand for milk is high. In these systems, cows are kept in barns and fed balanced rations to maximise milk production. According to Bebe et al (2003), some large dairy farms in Kenya are opting for intensive systems incorporating modern technologies such as mechanical milking, computerised herd management and advanced animal nutrition techniques. These systems offer the potential for high and consistent milk production, but require significant investment in capital and skills.

5. Factors influencing farming systems

Many factors influence the productivity of dairy cows in sub-Saharan Africa:

5.1. Availability of natural resources

Access to water and pasture is crucial for extensive and semi-intensive systems. According to the study by Thornton and Herrero (2010), climate variations and frequent droughts can affect the availability of these resources.

5.2. Market access

According to the study by Staal, Pratt and Jabbar (2008), intensive systems are often located near urban areas where demand for milk is higher. Proximity to urban markets and milk collection centres influences the profitability of farming systems.

5.3. Government policies

Dairy farming support policies, such as subsidies, agricultural credits and rural development programmes, play an important role in the development of livestock farming systems (Duteurtre and Corniaux, 2013).

5.4. Breeders' knowledge and skills

Training and access to information on good livestock management practices, animal nutrition and veterinary health are essential for improving the productivity of livestock systems (Moll and Kaganzi, 2008).

6. Constraints and challenges for dairy farmers

Dairy cow farming in sub-Saharan Africa faces a number of constraints and challenges.

6.1. Economic constraints and access to markets

Dairy farmers in sub-Saharan Africa face major economic challenges, such as the high cost of agricultural inputs, low profitability due to the volatility of milk prices on local and regional markets, and difficulties in accessing formal markets. According to the study by Bebe et al (2003), these economic constraints can hamper the financial viability of family dairy farms.

6.2. Natural resource management and climate change

Sustainable management of natural resources is a crucial challenge for dairy farmers, particularly in contexts where pressure on agricultural land is high. According to Herrero et al (2010), climate change adds further complexity by affecting rainfall patterns, available pasture and animal health.

6.3. Access to veterinary services and health management

According to Grace et al (2013), limited access to veterinary services and quality veterinary medicines is a major obstacle for dairy farmers. Animal diseases such as foot and mouth disease and mastitis can have a significant impact on herd productivity and farmers' incomes.

6.4.Access to food resources

Access to feed resources is a major challenge for dairy cow farming in sub-Saharan Africa. Farmers face difficulties in obtaining adequate feed for their cows due to various factors, such as the limited availability of grass and quality fodder. This can lead to lower milk production and health problems for the cows. In addition, the high cost of concentrates often makes them difficult to access for many farmers with limited financial resources. To overcome these constraints, it is essential to put in place agricultural development programmes that encourage growth in fodder production and provide financial support to farmers for the purchase of feed for their cows.

6.5.Low level of training of farmers

Low levels of farmer training are a major challenge in dairy farming in sub-Saharan Africa. Many farmers lack the knowledge and skills to manage their dairy herds effectively, which limits their ability to maximise productivity and income. A lack of knowledge about nutrition, animal health, reproductive management and genetic selection can have a significant impact on dairy cow performance. To remedy this situation, it is important to set up training and education programmes for farmers, to build their capacity and equip them with the skills they need to improve the management of their dairy herds. In addition, the exchange of knowledge and experience between farmers can also help to improve the level of training and encourage the adoption of more efficient husbandry practices. According to Gebremedhin et al (2007), the adoption of modern husbandry practices and access to appropriate agricultural technologies, such as livestock genetic improvement and irrigation systems for fodder crops, are major challenges for many dairy farmers in the region.

7. Good practice and innovation in dairy farming

Good practice and innovation in dairy farming in sub-Saharan Africa are essential to improve productivity and profitability. Farmers can adopt various strategies to optimise their results. One of these is to improve cow nutrition, ensuring that cows receive balanced, high-quality feed. This can include the use of nutritional supplements and concentrated feed to make up for any deficiencies. In addition, the introduction of advanced reproductive techniques such as

artificial insemination or genetic selection can help to improve cow reproduction and achieve better fertility rates. Finally, the use of modern milking technologies, such as mechanised milking systems, can facilitate the milking process and increase the efficiency of milk production.

7.1.Improving cow nutrition

Improving the nutrition of dairy cows in sub-Saharan Africa is essential to maximise their milk production. Farmers can use several strategies to achieve this objective. Firstly, they need to provide balanced rations made up of an appropriate combination of forage, concentrates and nutritional supplements. Access to quality feed resources is also crucial. Farmers can opt to graze on nutrient-rich land or grow forage crops suited to their climate. In addition, the use of feed conservation techniques, such as silage or hay, can ensure a regular supply of feed during periods of shortage. Finally, the provision of an adequate quantity of clean, fresh water is essential for maintaining the health and milk production of cows.

7.2.Advanced reproduction techniques

Advanced reproductive techniques are used in dairy farming in sub-Saharan Africa to improve animal fertility and reproduction. Artificial insemination (AI) is one such technique that has been widely adopted. It allows the use of semen from bulls of high genetic quality, thus improving the potential of dairy cows. AI also offers an effective alternative to natural reproduction, allowing farmers to control and optimise herd reproduction. In addition, the heat synchronisation technique is used to group cows in heat and facilitate the use of AI on a large scale. These advanced reproduction techniques are helping to increase the productivity and genetic improvement of dairy herds in sub-Saharan Africa.

7.3.Use of modern milking technology

The use of modern milking technologies offers many advantages in dairy farming in sub-Saharan Africa. Farmers can opt for mechanised milking systems, such as automated milking machines, which enable faster, more efficient and more hygienic milking. These systems reduce milking time and minimise the risk of milk contamination by pathogens. What's more, they improve cow comfort, reduce stress and promote higher milk production. Modern milking technologies are also accompanied by milk management systems, such as refrigeration and adequate storage, to guarantee the quality and safety of the milk produced.

The adoption of these technologies enables farmers to optimise their milk production and access markets that are more demanding in terms of quality and standards.

8. Environmental impact of dairy farming

Dairy farming has a significant environmental impact in sub-Saharan Africa. Greenhouse gas emissions are one of the main problems associated with this activity. Cows produce methane when digesting their feed, which contributes to global warming. In addition, intensive dairy farming leads to land and water degradation. Pastures are often overgrazed, leading to a reduction in soil fertility and a deterioration in water quality. Livestock waste management is also a challenge. Cow excrement contains nutrients that can contaminate water sources if not properly managed.

8.1. Greenhouse gas emissions (GHG)

Greenhouse gas emissions are a major environmental impact of dairy farming in sub-Saharan Africa. Cows produce methane, a more potent greenhouse gas than carbon dioxide, when digesting their feed. According to Gerber et al (2013), dairy farming contributes to greenhouse gas emissions, mainly through the production of enteric methane by ruminants. These emissions contribute to global warming. Efforts must be made to reduce these emissions, in particular by improving cow feeding practices and promoting more sustainable farming systems.

8.2. Land and water degradation

Intensive dairy farming contributes to land and water degradation. Pastures are often overgrazed, leading to a reduction in soil fertility and erosion. Deforestation to create new pastures exacerbates this problem. In addition, the dairy industry requires large quantities of water for the needs of the cows and for milk production. This can lead to overexploitation of water resources and contamination of water sources by livestock waste (Steinfeld et al., 2006). Sustainable land and water management measures need to be put in place to limit these negative impacts.

8.3. Management of waste from dairy cows

Livestock waste management is a major challenge in dairy cow farming in sub-Saharan Africa. Cow excrement contains nutrients such as nitrogen and phosphorus, which can be beneficial if used as fertiliser. However, if this waste is not properly managed, it can pollute soils and water sources (Thornton and Herrero, 2010). Storage and treatment systems for

Comment [KA3]: *Contribution to the Local and National Economy*
"Dairy farming contributes significantly to the GDP of sub-Saharan African countries, such as Kenya, Ethiopia, and Uganda. According to FAO estimates, milk production can account for 4-8% of agricultural GDP in some of these countries (Staal, Pratt, and Jabbar, 2008)."
Job Creation and Income Generation
"The dairy sector offers direct employment for farmers and indirect employment in the value chain, including transport, processing, and marketing of milk. For instance, around 1.6 million households in Tanzania rely on dairy production for their livelihoods (Otte and Upton, 2005)."
Multiplier Effects on the Economy
"Milk-producing households often reinvest their income in local goods and services, stimulating the rural economy. In Kenya, profits from milk are frequently used to educate children, improve housing, and purchase other livestock (Wambugu, Kirimi, and Opiyo, 2011)."
Impact on Food Security and Poverty Reduction
Issues:
- Repetition in emphasizing the importance of dairy farming.

Suggestions:
- Consolidate repetitive statements to enhance readability.

Revised Section: "Dairy farming plays a crucial role in improving food security and reducing poverty in sub-Saharan Africa. It provides a regular source of nutritious dairy products and generates stable income, enabling households to diversify their diets and invest in better living conditions."
Existing Dairy Farming Systems
Issues:
- The transition between different farming systems can be smoother.
- Some technical terms may need further explanation for clarity.

Suggestions:
- Improve transitions and add brief explanations for technical terms.

Revised Section: "Dairy farming systems in sub-Saharan Africa vary based on resources and traditional practices. Extensive farming relies on abundant grazing resources, semi-intensive farming combines traditional and modern techniques, and intensive farming, though less common, is found in urban areas with high milk demand."
Factors Influencing Farming Systems
... [3]

livestock waste are often inadequate, leading to risks for the environment and human health. It is crucial to adopt appropriate livestock waste management practices, such as the creation of purification farms, to minimise the environmental impact of dairy farming.

9. Policies and programmes to support dairy farming in sub-Saharan Africa

Policies and programmes to support dairy farming in sub-Saharan Africa play a crucial role in the development of this sector. They include initiatives such as subsidies and financial incentives to encourage farmers to invest in dairy farming. These incentives aim to reduce production costs, improve economic efficiency and increase farmers' incomes. Governments and international organisations set up these programmes to encourage the growth of dairy farming and thus contribute to the economic development of the region.

9.1.Subsidies and financial incentives

Subsidies and financial incentives are essential tools for supporting dairy farming in sub-Saharan Africa. Governments and international organisations provide subsidies to farmers to help them acquire modern milking equipment and materials, improve livestock infrastructure and build their technical capacity. According to MOaALR (2015), in Ethiopia, the government has launched the 'National Livestock Development Plan' which includes specific measures to improve the productivity and sustainability of dairy farming. In addition, financial incentives are provided in the form of loans at preferential rates for the purchase of dairy cows of high genetic quality. In this sense, the African Development Bank (AfDB) has launched financial support programmes for smallholder dairy farmers in sub-Saharan Africa, facilitating access to credit and investment in agricultural infrastructure (AfDB, 2018). These measures aim to encourage farmers to invest in dairy farming and improve the productivity and profitability of their farms.

9.2.Training and education of farmers

Farmer training and education are key to improving dairy farming in sub-Saharan Africa. Governments and organisations are developing training programmes to enhance farmers' skills and knowledge. For example, the Food and Agriculture Organization of the United Nations (FAO) has implemented training and capacity-building programmes for dairy farmers, particularly in the areas of sustainable animal husbandry practices and efficient resource management (FAO, 2021). These programmes cover topics such as feed management, animal health and welfare, reproductive management and genetics. They also provide advice on good husbandry practices and advanced techniques. By strengthening the

training and education of farmers, we can expect to see an improvement in the productivity and profitability of dairy farming in sub-Saharan Africa.

10. Conclusion

The literature review on dairy farming in sub-Saharan Africa highlights the crucial importance of this sector for the region's economy, food security, nutrition and rural development. An analysis of the various aspects of dairy farming reveals a number of findings and recommendations:

Firstly, dairy farming makes a significant contribution to the local and national economy, creating jobs, generating income for rural communities and contributing to agricultural GDP. However, major challenges such as environmental and climatic constraints, socio-economic challenges and the risks associated with animal diseases persist and require particular attention from stakeholders in the sector and political decision-makers.

Secondly, despite these challenges, significant opportunities exist for the development of the dairy sector in sub-Saharan Africa. Increasing demand for dairy products, both domestically and internationally, offers opportunities for growth and investment. Strategies focused on improving productivity, adopting innovative technologies, promoting sustainable farming practices, and strengthening infrastructure and human capacity can help to exploit these opportunities to the full.

Thirdly, to ensure the sustainable and inclusive development of the dairy sector, coherent government policies, appropriate support programmes and effective public-private partnerships are needed. These initiatives should aim to strengthen farmers' resilience in the face of environmental and economic challenges, improve access to markets and agricultural inputs, promote technological innovation, and guarantee high quality and food safety standards.

In conclusion, the literature review highlights the crucial importance of dairy farming for the sustainable development and prosperity of rural populations in sub-Saharan Africa. An

integrated approach, combining policy measures, strategic investments, and active engagement of stakeholders in the dairy value chain, is essential to overcome the current challenges and realise the full potential of the dairy sector in the region.

11. Recommendations for improving dairy cow breeding

To improve dairy cow rearing in sub-Saharan African countries, a number of recommendations are made: firstly, it is crucial to improve access to feed resources for cows, by developing feed management practices adapted to the local context and promoting access to pasture and quality concentrated feed. It is also essential to strengthen disease and parasite prevention and control measures, by introducing regular vaccination programmes and encouraging the use of appropriate medicines. In addition, it is necessary to develop infrastructures and technologies linked to dairy farming, by facilitating access to clean water, modern milking facilities and waste management. Finally, it is vital to strengthen the training and education of farmers, by setting up technical training programmes and encouraging the exchange of knowledge and experience between farmers. These recommendations will help to promote sustainable improvements in dairy cow farming in sub-Saharan Africa.

Comment [KA4]: Environmental Impact of Dairy Farming

Issues:
- Some impacts are not discussed in depth.
- Potential solutions to mitigate environmental impact are not mentioned.

Suggestions:
- Discuss each environmental impact in detail.
- Suggest mitigation strategies.

Revised Section: "Dairy farming in sub-Saharan Africa has significant environmental impacts, including greenhouse gas emissions, land and water degradation, and waste management challenges. Strategies to mitigate these impacts include improving cow feeding practices, adopting sustainable land management techniques, and implementing effective waste management systems."

Policies and Programs to Support Dairy Farming

Issues:
- More examples of successful programs would be beneficial.
- The impact of these policies needs to be more clearly stated.

Suggestions:
- Provide additional examples of successful policies and programs.
- Clearly state the positive impacts of these initiatives.

Revised Section: "Policies and programs play a crucial role in supporting dairy farming in sub-Saharan Africa. Subsidies, financial incentives, and farmer training programs have been implemented to encourage investment and improve productivity. Successful initiatives, such as Ethiopia's 'National Livestock Development Plan' and AfDB's financial support programs, have significantly benefited the dairy sector."

Conclusion

Issues:
- The conclusion is somewhat repetitive and could be more concise.

Suggestions:
- Summarize the key points more succinctly.
- Avoid repetition of information already covered in the article.

Revised Section: "This literature review highlights the crucial role of dairy farming in sub-Saharan Africa's economy, food security, and rural development. Despite significant challenges, opportunities for growth and investment exist. To achieve sustainable development in the dairy sector, coherent government policies, strategic investments, and active stakeholder engagement are essential."

Recommendations for Improving Dairy Cow B...

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