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INFLUENCE OF DAIRY FARMING PRACTICES ON MILK PRODUCTION. A CRITICAL LITERATURE REVIEW

By

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Abstract

Purpose: Dairy farming has been part of agriculture for thousands of years since the early days of man when he decided to start domesticating animals. This paper aims to determine the extent to which dairy animal nutrition and animal health influences the level of milk production. The aim of the study is also to determine the role played by animal hygiene in improving and sustaining milk production as well as the extent to which observance of animal welfare influences the performance of the cattle in terms of mil production.

***Methodology*:** This paper adopted a desk study review methodology where relevant empirical literature was reviewed to identify main the themes.

Findings: The study deduced that animal nutrition to a very great extent influence milk production. The study found out that preserving water supplies and feeds from contamination and feeding animals on good quality feeds influenced milk production to a very great extent. Adopting appropriate farm management practices such as milking hygiene, environmental sanitation, and regular veterinary care (e.g., periodic check-ups, prompt treatment of illness) of cows helps to assure the well-being of dairy cows and reduce their risk of infections such as clinical mastitis. It is important to ensure good milking techniques since incorrect techniques can result in a higher mastitis risk and injury to the cow which translates to lower level of milk production or even contamination of milk.

Recommendations: Creating awareness on the dairy farming practices, changing behavior and being equipped in the necessary skills on dairy farming practices would improve the level of milk production.

Keywords: *Animal nutrition, animal health, dairy farming practices, dairy animal health*

1.0 Introduction

1.1 Background of the study

Dairy farming has been part of agriculture for thousands of years since the early days of man when he decided to start domesticating animals. Britain pioneered in dairy farming after the agrarian revolution which then spread to other parts of Europe and America during the scientific revolution in the 18th century. The industry then extended to the Balkan lands namely Denmark, Norway, Sweden, the Netherlands and ultimately to Africa through ancient Egypt. Historically it has been one part of small, diverse farms. In the last century or so larger farms doing only dairy production did emerge. In New Zealand dairy cattle were first imported by European settlers in the early 19th

Century to provide milk, butter and cheese for local supply. As early as 1846, only six years after the signing of the Treaty of Waitangi, the first dairy exports to different parts of Europe began. In 1882 New Zealand exported the first refrigerated shipment - a worldwide first - of meat and butter from Port Chalmers, Dunedin to London on the ship "Dunedin" (East, A. R. (2018)

The 1930s to the 1960s saw the beginnings of the industry consolidation. As technologies in transport and refrigeration improved - for example, cooling of milk on-farm was introduced. By 1955 co-operatives began joining forces to become more efficient. By the 1960s, New Zealand's 400 co-operatives had become 168.By the 1980s, the New Zealand Dairy Board had 19 subsidiaries and associated companies around the world. By 1990 it had 40 and by 1995, 80. In a little more than 10 years, the New Zealand Dairy Board became the world's largest dedicated dairy marketing network (Jelani, M. J. B. 2016) Since the 1960's dairy farming in The Netherlands has gone through a metamorphosis. The average number of cattle per farm has increased sevenfold: from 9 to 66 animals. Modern free roaming stables today can even keep up to 1000 animals. At the same time one man by 2007 produced 17 times the amount of milk that one man in 1960 produced.

In Africa milk producing animals have been domesticated for thousands of years. Initially, they were part of the subsistence farming that nomads engaged in. As the community moved about the country, their animals accompanied them. Protecting and feeding the animals were a big part of the symbiotic relationship between the animals and the herders. The industry has been growing gradually in Africa where traditional systems have dominated milk production 2 for several years and still supply considerable amounts of milk today accounting for above 90% of dairy ruminant population in Sub-saharan Africa (Kubkomawa, H. I. 2017). Indigenous groups like the Maasai, Borani, Fulani and Tuareg have a strong historic dairy tradition. They share many customs and regard milk as a product of harmony that is offered free to relatives, friends and visitors. Due to population growth, land shortage and increasing interest in production and consumption, market-oriented dairy systems are now evolving, with the use of high performing graded animals and/or higher inputs. Several international bodies (Heifer Project International, Land O'Lakes, Send a Cow, etc.) have developed strategies to promote milk production in African countries. These bodies usually have two main objectives: Improving on milk consumption especially by poor families (nutrition improvement) and increasing on farm returns from dairy farming (income generation and poverty alleviation). Therefore, it is important to see how dairying has evolved in Africa as a whole and in individual African countries as well. The growth of the dairy industry between 1990 and 2004 saw the demand for milk and dairy products in Africa growing at an average rate of 4.0% per annum; meanwhile production only grew at a rate of 3.1%. Growth in consumption was pushed both by a growth in population (of 2.8% per annum) and a small growth in per capita milk consumption (of 0.8% per annum) between1990 and 2004 (FAOSTAT 2006; IFCN Sector model 2006).

In Kenya one of the oldest pastoral systems was and is still practiced by the Maasai in the sparsely populated semi-arid range-lands. The Maasai are nomadic pastoralists who live in extended families of 10-15 people with herds averaging 100-170 cattle and as many sheep and goats. In this system, milk surplus is shared with neighbors or exchanged in barter, but is rarely sold except by households living close (<5 km) to main roads and urban centers where there is demand for fresh

and fermented milk, and butter. The Borana pastoral system 3 is similar to that of the Maasai. Here, the frequency and amounts of dairy products traded depend on herd size and distance to the market. Milk sales in the Borana system is however of higher interest than is the case with the Maasai (Anbacha, A. E., & Kjosavik, D. J. (2021)

Kenya has enjoyed 100 years of experience with exotic breeds of dairy cattle, while surrounding countries such as Ethiopia and Uganda have not. The resulting accessibility of improved cross-breeds, well established artificial insemination and veterinary services, and marketing infrastructure offer an important springboard on which smallholder farmers have been able to build. Other countries without this historic endowment of dairying expertise and facilities will likely face longer lead times in expanding smallholder dairy production (Johnston, B. F. et al 2018)

Widespread introduction of highly productive breeds of dairy cows, or grade cattle, has been the major source of increased productivity in Kenyan dairying. Provision of efficient and affordable reproductive services has therefore remained a central pillar of the country's dairy development strategy. In the early decades following independence, from 1964 to 1987, government heavily subsidized artificial insemination services. Though expensive, this strategy did result in widespread adoption of improved breeds. This however must incorporate many other dairy farming practices to be successful (Stock, K. F. et al 2015).That is the reason as to why there is a higher market orientation in large intensive systems and more emphasis is laid on feeding and breeding management to assure optimal production (Pawar S. et al, 2016). This has seen Kenya dairy industry grow where improved dairy cattle account for 23 percent of the total cattle population within the central highland as well as the Rift valley regions, and 75 percent of all specialized dairy cattle in Eastern and Southern Africa. In contrast, improved breeds account for only 3 percent of dairy cattle in Uganda and less than 1 percent of total cattle in Ethiopia.

Most of the breeds that are found in Kenya are mostly exotic which include Ayrshire which originated from Scotland; known for vigor and efficiency of milk production due to the quality of its udder. It is known to thrive well in the cold Kenyan highlands. Guernsey whose Origin is the English Channel, 30 miles off the coast of France. Her milk is yellow due to the butter fat content. She is hearty and adaptable ().Jersey, whose origin is the island of Jersey 15 miles off the coast of France and is known to produce more butterfat in her milk than other dairy breed. Friesian, the biggest of the dairy cows, having originated from the Netherlands. She is the world's most popular dairy breed. It is famed with producing large quantities of milk (Groot, M. J., & van't Hooft, K. E. 2016).

1.2 Statement of the problem

Milk production has really improved over the years with the embracing of different and modern milk production techniques. It is, however, observed that the farmers have not realized the optimal production of the same, and are thus operating below peak (Groot, M. J., & van't Hooft, K. E. 2016). It is, therefore, important to acknowledge that good dairy farming principles are vital in attaining maximum milk production. An animal's health and productivity, along with the quality and safety of her milk are key though dependent on the quality and management of the feed and water. Animal welfare has been a primary concern as it deals with the well-being of the animal. In general, consumers perceive high animal welfare standards as an indicator that food is safe, healthy and of high quality. Increasingly, consumers are concerned that the production of food is being

undertaken in harmony with the environment in respect to socioeconomic management. To meet these concerns, it is important that farmers produce milk in a way that minimizes any damage to the environment.

Despite the growth in dairy farming over the years, there is a lot of imbalance experienced in different areas based on the approach from different farmers. Majority of farmers still fail to understand the connection between dairy productivity and farming practices. Without careful analysis of the patterns of benefits that can be reaped from good farming practices, we cannot accept at the face value that dairy farming can be both fulfilling and satisfying (East, A. R. (2018).

One of the major problems among the farmers is the choice of feeds they give their dairy animals. Some of the feeds do not have the right nutrients capable of boosting milk quality and quantity. Most of the farmers do not extend any meaningful consideration to the type of feeds and they deal with the same feeds all year round. This is coupled by ignorance to animal health where farmers take a lot of time or ignore administration of healthcare to animals even after changes in weather (Ankeny, R. A. 2021). Animal hygiene is important and all dairy farmers, suppliers to dairy farmers, milk carriers and hauliers, dairy product and food manufacturers, distributors and retailers should be part of an integrated food safety and quality assurance management system. Good farming practices underpin the marketing of safe, quality-assured milk based products. It was from this understanding that the researcher drew out the role of dairy farmers which is primarily to ensure that good agricultural, hygienic and animal husbandry practices are employed at the farm level. This study therefore, sought to determine the influence of good dairy farming practices on milk production as it gave a better comprehensive understanding in order to suggest some commendable dairy farming practices.

1.3 Objectives of the study

To determine the extent to which dairy animal nutrition and animal health influences the level of milk production. The aim of the study is also to determine the role played by animal hygiene in improving and sustaining milk production as well as the extent to which observance of animal welfare influences the performance of the cattle in terms of mil production.

1.4 Significance of the Study

The purpose of this study was to determine the influence of dairy farming practices on milk production. This will provide useful information to dairy farmers since a lot of emphasis has been laid on the aspect of growth and sustainability of the industry which should be managed effectively. This will assist farmers develop strong and dynamic dairy farming practices that will effectively offer them the desired results in a bid to help them reap great benefits from the industry. The same will improve community's approach to the right dairy farming practices.

Findings of this study will contribute to the information resource for use by various organizations and governments for the purpose of advancing dairy farming practices and making it a useful approach to community development. The study will also be invaluable to various policy makers in formulation of regulation governing the industry to increase milk production resulting in national food security through improvement in the quality of milk products, creating employment opportunities both in the rural and urban areas in line with the Millennium Development Goals and Economic Recovery Strategy. Similarly, researchers will find this useful in advancing their

knowledge on the subject and offering a good link to further research as the sector continues being more dynamic. Findings of this study will benefit other development partners interested in improving the dairy sector. Finance institutions will find this study useful in understanding the nature of industry of their clientele which is mainly the farmers' cooperatives. They will therefore be in a better position to address the challenges facing them and farming industry in general. The financial institutions will be able to delve into the dynamics that influence their good use of the financial services they extend to them. Ultimately, this will help in packaging their services effectively and facilitating successful financial advisory initiatives with the relevant farmers' cooperatives.

2.0 LITERATURE REVIEW

2.1 Dairy Animal Nutrition Perspective

Proper feeding and good balanced rations remains the cornerstone of a successful dairy operation. Milk yield per cow and the cost of feed to produce milk have by far the greatest influence on profitability in a dairy operation. If a dairy is to be successful, the dairymen must continually strive to adopt practices that allow the greatest output of milk at the most economical cost. Successful dairying in the future will depend on high levels of milk production, culling for low production, controlling feed costs, and using good replacements (Wattiaux, M. A. 2020). Cow identification and good records make good feeding practices possible. Without milk production records, it is difficult to feed according to milk production or to use any well designed group feeding system. Milk yields per cow continue to increase annually as reported by the USDA National Agricultural Statistics Service. Average production per cow in the United States reported in 1975 was 10,360 pounds as compared to 56,213 pounds in 2001. Much of this increase in milk production is due to better nutrition and feeding, overall management practices and the genetic improvement of the cow population. Feeding standards have been used since the late 1800s to help guide nutritionists and livestock producers in formulating rations and feeding livestock. Periodically, the standards are updated to encompass the most current research information available. The standards that are now available, entitled "Nutrient Requirements of Dairy Cattle," were updated in 1988 by a subcommittee on Dairy Cattle Nutrition of the National Research Council (White, R. R et al 2017). As milk production increases, it becomes important that some dietary protein escape degradation in rumen fermentation. Protein that bypasses the rumen is degraded to amino acids and absorbed from the small intestine for utilization (Abbasi, I. H. R et al 2016).These essential amino acids are needed by the high producing cow and must come either from dietary protein that escapes degradation or microbial protein produced during rumen fermentation and passed along to the small intestine.

The most critical period in the cow's lactation is from parturition until peak production which takes from 5 to 8 weeks postpartum. It is during this period that the stage is set for obtaining the highest possible peak in production and also for the onset of normal reproductive cycling which may occur as early as 2 to 3 weeks in some cows. To be successful, the best strategies must be applied that include many areas such as feeding and management practices, quality and balance of feed, feed bunk management, milk practices, and the maintenance of good health (Muller A. 2017).

2.2 Influence of nutrition on milk production

Nutrition of the dairy cow affects the yield and proportion of milk components including protein, carbohydrates, vitamins and minerals. Proper feeding management of the dairy herd can improve the cattle production efficiency and provide for a healthier cow. Feeding to increase production of milk with maximum levels of milk fat and protein is essential for achieving these benefits. An animal's health and productivity, along with the quality and safety of her milk, depend on the quality and management of the feed and water. Milk quality can be affected adversely by the quality of feeds they ingest. If the water is contaminated, the contaminants may cause milk safety and quality to suffer. Better understanding of the processes involved in animal nutrition could also contribute to improved management of some of the trade-offs that operate at high levels of animal performance, such as those associated with lower reproductive performance (Partridge, G. 2015)

Proper nutrition is critical to enable modern, high-producing dairy cows to meet their genetic potential for milk production (VandeHaar, M. 2016). In fact, increases in milk production per cow over the past100 years can be attributed in large part to improvements in nutrition. Dairy farmers use professional animal nutritionists to develop scientifically formulated, balanced, and nutritious diets to support milk production, while optimizing nutrient management programs and minimizing pollution. Diets for cows include hay, grains, protein sources (e.g., soy) and vitamins and minerals. It is important to continually assess cows' nutrient intakes and their body condition as different weather conditions can influence their nutrient requirements (Muriuki, 2012).

While understanding of the science of animal nutrition continues to expand and develop, most of the world's dairy animals in many developing countries suffer from permanent or seasonal nutritional stress (Varma, G. 2015). Poor nutrition is one of the major production constraints in smallholder systems, particularly in Africa. Research has been carried out to improve the quality and availability of feed resources, including work on sown forages, forage conservation, the use of multi-purpose trees, fibrous crop residues and strategic supplementation. There are also prospects for using novel feeds from various sources to provide alternative sources of protein and energy, such as plantation crops and various industrial (including ethanol) by-products. The potential of such feeds is largely unknown. Given the prevalence of mixed crop–livestock systems (where animals and crops are grown on the same farm) in many parts of the world, closer integration of crops and livestock in such systems can give rise to increased productivity and increased soil fertility. In such systems, smallholders use crops for multiple purposes (food and feed, for example), and crop breeding programs are now well established that are targeting Stover quality as well as grain yield in crops such as maize, sorghum, millet and groundnut. Considerable work is however under way to address some of the issues associated with various anti-nutritional factors.

Improved feed availability and quality will be a key strategy to realize the largest proportion of the needed animal productivity levels and supporting animal population increases. Feeding is the major constraint to achieving the targeted milk production because of heavy dependency on rain-fed forage and pasture production while there is poor adoption of conservation of animal feeds to smoothen seasonal fluctuations in milk production. Efficient utilization of dairy concentrates is needed to match the high cost of quality concentrates and weak enforcement of standards that has failed to discourage infiltration of substandard commercial feeds into the market. According to the

Dairy Master plan (2019), the actions that can enhance better feeding for increased animal productivity include the following: increase acreage under pasture and fodder, increase availability of seeds of improved forage varieties, promote adoption of feed conservation technologies, enforce standards of both raw materials and finished concentrates and train more farmers to make home ration formulation and on mixing of feeds. These feeding strategies when adopted will enhance reproductive performance in the national herd.

Feeding of a dairy cow is very important as a high and economic milk production can only be achieved with well-fed cow. The cost of feeding contributes highest to total cost of milk production. If a cow is kept under zero grazing, feeding needs even more attention as she will entirely depend on how the farmer feeds her. A dairy cow requires feed for the following purposes: milk production, body maintenance, her own growth and the growth of the calf (if pregnant). This implies that the cow should receive a ration balanced in energy, protein and minerals. Unbalanced ration leads to decreased milk production, poor body condition of the cow and fertility problems. Good feeding leads to higher milk production, good health, and more calves. However, good quality feeds are expensive. Feeding is the major constraint to achieving the targeted milk production because of heavy dependency on rain-fed forage and pasture production while there is poor adoption of conservation of animal feeds (Adegoke, A. T., & Abioye, A. A. (2016) Feeds can be divided into two groups, roughages and concentrates. Roughages are bulky feeds like Napier grass, maize stover, Lucaena, banana stem, sweet potato vines, hay and silage. These feeds are usually grown on the farm and are the cheapest to feed to the cow. Good quality roughage is the basis of a high milk production. Roughages like maize Stovers, banana stems, yellowish Napier grass and silage of Napier grass are low in protein. In order to compensate for this shortage, roughages rich in protein like Leucaena, desmodium, sweet potato vines, leaves of fodder trees should be added to balance the ration (Ministry of Livestock Development).

In addition to improving milk production, nutrition impacts animal health and well-being (Sauerwein, H. 2018). Cows that are fed properly have fewer metabolic diseases and better immune function. Also, cows' diets can influence the environment and efficient use of the earth's natural resources. Because feeding excess nitrogen and phosphorus to cows contributes to air and water pollution, modifications in cows' diets are made to find the right balance of nutrients to increase milk production while minimizing environmental pollution.

With respect to using the earth's resources efficiently, proper nutrition leads to higher milk production which is associated with a greater proportion of feed nutrients being converted to milk (Heinrichs, A. J., & Jones, C. M. (2016). Advances in nutrition have been and will continue to improve the productivity of dairy cows, as well as the dairy industry's role as stewards of the environment. Feeds used in Kenya have been reported to be of low quality and in some cases contaminated with aflatoxins which have been found in milk. A study by the University of Nairobi on the prevalence of contaminants in dairy feeds in Nairobi peri-urban concluded that 50% of commonly used maize germ, cotton seed meal, wheat bran was contaminated with aflatoxins and pose serious implications on livestock and human health.

2.3 Animal Health Influence on Milk Production

A number of hygiene scoring systems for dairy cows have been developed to record the degree of contamination of different anatomical areas with dirt and fecal matter, thus giving an overall

assessment of the cleanliness of the whole animal (Datta, S. 2021). Hygiene scoring of cattle is routinely used in the beef industry in the UK to assess the cleanliness of cattle prior to slaughter as part of the Clean Livestock Policy to reduce the potential risk of contamination of carcasses with dirt and fecal material (Meat Hygiene Service) There is increasing interest in, and demand for, animal-based assessment of livestock from organic and conventionally managed farms, allowing benchmarking between farms and to compare the effects of different management systems. Animals should be observed regularly and proven methods used to aid in detection and accurate diagnosis of infectious diseases. The diseases should be treated by proven methods after accurate diagnosis to minimize the prevalence of infection. Also, sick animal should be isolated from the other cattle on the premises to minimize the spread of diseases. Appropriate procedures to separate milk from sick animals and animals under treatment should be followed to prevent further contamination. It is important that other people handling dairy cattle for example veterinarians know what treatments have been given to the cows. An appropriate system should be put in place to readily identify treated animals (for example paint udders treated for mastitis) (Rees A. 2017)

Residues of any chemical administered have the potential to damage milk markets. Farmers should manage the use of all chemicals to prevent unacceptable chemical residues occurring in milk as unsuitable chemicals adversely affect animal health and productivity. Farmers need to be aware of all chemicals that may leave residues in milk. These may include detergents, disinfectants, anti-parasitic, antibiotics, herbicides, pesticides and fungicides. Farmers should use chemicals only for the purpose for which they are approved - lactating cows should never be treated with veterinary products that are not recommended for treatment of cows producing milk supplied for processing or otherwise used for human consumption; read the label - it should contain all the information about legal and safe use of the chemical; follow the advice given on the label and any chemical data sheet or risk assessment; observe withholding periods (the minimum times when milk should not be sold for human consumption after application of chemicals). It is important to note that veterinary medicines are chemical and biological products sold for the treatment of animals where evidence of proven efficacy and safety have been examined by independent review bodies to ensure that the products are suitable for their purpose (Ram, R. 2019). These medicines may require a prescription from a veterinarian to allow purchase and to confirm that their use is appropriate.

Proper animal care and environmental practices, as well as dairy food safety and quality, are priorities for all dairy farmers. Conventional dairy farmers, with the help of animal scientists and veterinarians, strive to provide dairy cows with comfortable living conditions, nutritious diets, and good medical care. Dairy farmers depend on healthy cows for their livelihood. Adopting appropriate farm management practices such as milking hygiene, environmental sanitation, and regular veterinary care (e.g., periodic check-ups, prompt treatment of illness) of cows helps to assure the well-being of dairy cows and reduce their risk of infections such as clinical mastitis (Ruegg, P. L. (2018). During the past 25 years there has been a major shift from treatment to prevention of disease in cows and, as a result of new technologies, subclinical conditions can now be identified. Veterinarians have contributed to the development of on-farm data management systems and computer software that allow for early detection of health problems and the tailoring

of disease prevention and treatment to individual herd needs (Castro-Costa, A., & Knight, C. H. 2016)

In the extremely rare event that any milk tests positive of the antibiotics, the milk is disposed of immediately, never reaching the public. Further, dairy farmers are financially liable if antibiotics are found in the milk. As a result of stringent government regulations, neither conventionally produced milk nor organically produced milk contains illegal antibiotic residues (Gomiero, T. 2018). To assure healthy air quality and avoid heat stress in dairy cows, most modern dairy farms use shades and advanced ventilation systems. On warm days, farmers use fans, foggers, misters, or sprinklers to effectively cool cows and improve milk production and reproductive efficiency. The health and performance effects of heat stress on dairy cows have been quantified.

2.4 Animal hygiene Influence on milk production

Despite its broader etymological sense, the word hygiene is related in many countries to cleanliness and to prevention of contamination. An agreement is generally found on the importance of hygiene in livestock production (Asmare, K. et al 2016).Milking being the most important single activity on the dairy farm means that consumers demand high standards of milk quality, so milking management aims to minimize microbial, chemical and physical contamination. Milking management covers all aspects of the process of obtaining milk from cows quickly and effectively, while assuring the health of the cows and the quality of the milk. This is attained through ensuring milking routines do not injure cows or introduce contaminants in milk; ensuring milking is carried out under hygienic conditions; ensuring milk is handled properly after milking (Cullor, J. S. 2019).

Quality of milk plays a very important role in ensuring that markets are accessible and that milk is able to be retained at retail level. This is because milk can be a carrier of life threatening diseases. The processor therefore puts measures in place to ensure that it is not compromised and farmers comply with the regulations on health standards throughout the dairy supply chain (Kiambi S. et al 2020) The quality should be acceptable for use both for the processor and producer regardless of whether the farmer is commercial or smallholder. This is important because when dealing with issues of food safety, hygiene becomes paramount. Since the farmers produce is based on composition and hygiene, the higher the butter fat, the more profitable the raw milk is. Nonetheless, proper milk hygiene is vital as it could be detrimental for those farmers for whom milk income significantly contributes to livelihoods. Although milk processing reduces the bacterial load, maintaining good quality at the producer level is cardinal.

In their quest to meet standard quality, some dairy farmers use a well-kept cloth to clean and Vaseline to lubricate the udder before milking. This is their way of re-inventing and reconstructing the technology to suit their circumstances. Due to the fact that composition and food safety are the key aspects in the criteria for accepting milk, it is vital that all producers comply with the quality and safety procedures throughout the process from production and collection to processing and distribution (Behnke, K., & Janssen, M. F. W. H. A. 2020). It is important to ensure good milking techniques. Incorrect techniques can result in a higher mastitis risk and injury to the cow. The correct technique is to prepare cows well before milking; avoid unnecessary air entering while attaching the cups to the milking glands when using machine milking, if applicable; minimize over milking; remove cups gently, if applicable. Cows whose milk is unfit for human consumption

should be milked last or with a separate bucket or system. Discard abnormal milk in a manner appropriate to the risk posed.

A sufficient supply of clean water should be available for milking operations and for cleaning equipment that comes into contact with milk. A high standard of cleanliness should be maintained at all times in the housing area. The housing area should be designed to provide good drainage and ventilation and to avoid animal injury as well as suitable in size and designed to match the size of the animal. The milking area should be designed to allow it to be kept clean and tidy (Kristensson, P. 2018). Management of manure is a complex environmental issue on farms of all sizes as manure can have both positive and negative environmental consequences (Kimani and Harris, 2001). Dairy farmers on both conventional and organic farms effectively recycle manure nutrients as a fertilizer to replenish soils so crops grow better, while avoiding pollution. Manure supplies plant nutrients, improves soil structure, aeration, and water-holding capacity of the soil, and promotes the growth of beneficial organisms in the soil. Engineers and other experts help dairy farmers design manure handling systems, from how animals are fed and housed, to manure handling and storage, transportation, land application of manure, land management, and record keeping.

2.5 Empirical view

Mugambi (2017), conducted a study on the estimation of milk production efficiency of dairy farms in Embu and Meru counties in Kenya. Data were collected from 135 randomly sampled farms in 2010. The sample size was determined using the Cochran's (1977) formula. Data were collected using semi-structured questionnaires, after which they were entered into the excel spreadsheets and edited. Stochastic frontier production and cost functions were estimated using the maximum likelihood estimation (MLE) technique. The results from the study showed that the number of lactating cows and the amounts of roughages, concentrates, and mineral supplements were the major factors influencing milk output, while the prices of roughages and labor caused most variation in the production cost. The mean farmers' technical and cost efficiency indices were 0.837 and 1.044, respectively. The function coefficient of the production model was 2.11. These results implied that milk production could be increased by 16.3% through better use of available resources given the current state of technology without extra cost, while the cost of milk production could be decreased by about 4.4% without decreasing output.

Otieno (2020), conducted a study on smallholder dairy farmers' typologies, collective action and commercialization in Kenya. The study was conducted in Nyandarua and Nakuru counties, where there are a large number of smallholder dairy farmers. The study used a multistage sampling technique to select a random sample of 380 dairy farmers. Structured questionnaires and focus group discussions were the tools for data collection. The data was analyzed using principal component analysis, cluster analysis, propensity score matching, and household commercialization index models. The results of the study showed that there were three significantly different types of smallholder dairy farmers i.e. low resource endowed and low market oriented, moderate resource endowed and moderate market oriented, and high resource endowed and high market oriented. The distinguishing factors for these dairy farming typologies were output, land, household assets, and infrastructure. Resources, capital, infrastructure, and extension service related challenges characterized the smallholder dairy sector. The majority of the smallholder dairy farmers practiced collective action, with most being in self-help groups.

Farmers joined groups depending on group leadership, education of leaders, leadership period, age of group, conduct of members, and execution of rules and regulations. Factors that affected group performance were type of group, gender of leaders, motivation to leaders, approach to absenteeism, years of group existence, and the reasons for lending to the group members. The study revealed moderately high level of commercialization in the study area even though there was low level of commercialization in Nakuru County compared to Nyandarua County. Major constraints to smallholder dairy commercialization included poor quality and quantity of inputs, low output prices, poor dairy related infrastructure, and inadequate extension services. The study concluded that milk production was relatively low among the farmers, who were heterogeneous in demographic and socio-economic characteristics. There was moderate farmer group membership in the study area, and also a substantial increase in milk sales for farmers who belonged to groups. Even though farmers practiced commercialization, the levels varied across the study area.

Philemon (2017), conducted a study on factors influencing the uptake of exotic dairy goats in Kitui West sub-County, Kitui, Kenya. The target population was smallholder farmers who kept exotic dairy goats in the four sub-clusters of Kitui West Sub-County. The sample size was 178 respondents who comprised 168 smallholder farmers and 10 Extension Officers. The researcher used descriptive research design in the study and applied random sampling technique to select the respondents. The researcher used questionnaire to collect quantitative and qualitative data from the smallholder exotic dairy goat farmers and an interview guide was used to engage Extension Officers in the Ministry of Agriculture, Livestock and Fisheries Development. Statistical package for social Sciences, version 21.0 was used to analyze data which was presented in percentages, frequencies and means using Tables. The results from the study showed that cultural background hindered the respondents from effectively engaging in exotic dairy goats farming. All the respondents were registered with respective Self Help Groups and some of them were registered with a Dairy Goats Association. Most of them reported practicing dairy goat farming for 5 years. A good number of the respondents had received training on dairy goat husbandry. Majority of the farmers watered their dairy goats once a day with a few of them dipping and spraying them once in a month to control diseases and external parasites while some Farmers had access to Veterinary services.

Mburu (2015), conducted a study on the effect of seasonality of feed resources dairy cattle production in coastal lowlands of Kenya. The objective of this study was to determine the effect of seasonality on availability and quality of feed resources on dairy cattle productivity in Coastal Lowlands of Kenya. A cross-sectional survey was conducted in Kwale and Kilifi counties on a random sample of 415 dairy cattle farms followed by a longitudinal survey on a purposive sample of 32 farms from the cross-sectional sample over a period of 12 months. Data from the cross-sectional survey was analyzed for descriptive statistics. Two-Step cluster analysis was used to classify small-scale farmers using variables selected apriori and identified four distinct clusters. The validity and stability of the 4-clusters solution was tested by splitting the sample into two sub-samples according to counties and cluster analyzed separately using the variables selected apriori. Discriminant analysis was done using demographic and socio-economic variables not previously considered in the cluster procedure in order to ascertain the profile of each cluster. The results from the study showed that dairy cattle obtained enough nutrients only in season. The crop-livestock production systems in study area were classified into four distinct clusters with distinct

production characteristics. Productivity was low within all the clusters and was attributed to poor quality cows and inadequate forage whose availability was seasonal. The available forages were of moderate quality with average to high rumen degradability. There was a deficit in DM availability during the dry season which could be remedied through conserving excess feed during the wet season

2.6 Research gaps

The contextual gap is a knowledge gap that considers the untapped potential or missing research literature in the geographical area that has not yet been explored or is underexplored. For instance Mugamni(2017), conducted a study on the estimation of milk production efficiency of dairy farms in Embu and Meru counties in Kenya. The results from the study showed that the number of lactating cows and the amounts of roughages, concentrates, and mineral supplements were the major factors influencing milk output, while the prices of roughages and labor caused most variation in the production cost. However, the study presented a geographical gap as it was conducted in Meru and Embu counties in Kenya whereas our current study sought to determine the extent to which dairy animal nutrition and animal health influences the level of milk production. The aim of the study is also to determine the role played by animal hygiene in improving and sustaining milk production as well as the extent to which observance of animal welfare influences the performance of the cattle in terms of mil production.

Methodological gap is the gap that is presented as a result in limitations in the methods and techniques used in the research (explains the situation as it is, avoids bias, positivism, etc.). The studies presented a methodological gap as a number of reviewed articles used sampling methods while our current study adopted a desktop literature review method.

3.0 METHODOLOGY

The study adopted a desktop literature review method (desk study). This involved an in-depth review of studies related to the influence of dairy farming practices on milk production. Three sorting stages were implemented on the subject under study in order to determine the viability of the subject for research. This is the first stage that comprised the initial identification of all articles that were based on the influence of dairy farming practices on milk production. The search was done generally by searching the articles in the article title, abstract, keywords. A second search involved fully available publications on the subject on the influence of dairy farming practices on milk production. The third step involved the selection of fully accessible publications. Reduction of the literature to only fully accessible publications yielded specificity and allowed the researcher to focus on the articles that related to influence of dairy farming practices on milk production which was split into top key words. After an in-depth search into the top key words (risk factors, Brucellosis, prevalence), the researcher arrived at 4 articles that were suitable for analysis.

These findings were articles by Mugambi (2017), who conducted a study on the estimation of milk production efficiency of dairy farms in Embu and Meru counties in Kenya. Data were collected from 135 randomly sampled farms in 2010. The sample size was determined using the Cochran's (1977) formula. Data were collected using semi-structured questionnaires, after which they were entered into the excel spreadsheets and edited. The results from the study showed that the number of lactating cows and the amounts of roughages, concentrates, and mineral supplements were the

major factors influencing milk output, while the prices of roughages and labor caused most variation in the production cost. These results implied that milk production could be increased by 16.3% through better use of available resources given the current state of technology without extra cost, while the cost of milk production could be decreased by about 4.4% without decreasing output.

Otieno (2020), conducted a study on smallholder dairy farmers' typologies, collective action and commercialization in Kenya. The study used a multistage sampling technique to select a random sample of 380 dairy farmers. Structured questionnaires and focus group discussions were the tools for data collection. The data was analyzed using principal component analysis, cluster analysis, propensity score matching, and household commercialization index models. The results of the study showed that there were three significantly different types of smallholder dairy farmers i.e. low resource endowed and low market oriented, moderate resource endowed and moderate market oriented, and high resource endowed and high market oriented. The distinguishing factors for these dairy farming typologies were output, land, household assets, and infrastructure. Resources, capital, infrastructure, and extension service related challenges characterized the smallholder dairy sector.

Philemon (2017), conducted a study on factors influencing the uptake of exotic dairy goats in Kitui West sub-County, Kitui, Kenya. The target population was smallholder farmers who kept exotic dairy goats in the four sub-clusters of Kitui West Sub-County. The sample size was 178 respondents who comprised 168 smallholder farmers and 10 Extension Officers. The researcher used descriptive research design in the study and applied random sampling technique to select the respondents. The researcher used questionnaire to collect quantitative and qualitative data from the smallholder exotic dairy goat farmers and an interview guide was used to engage Extension Officers in the Ministry of Agriculture, Livestock and Fisheries Development. The results from the study showed that cultural background hindered the respondents from effectively engaging in exotic dairy goats farming. All the respondents were registered with respective Self Help Groups and some of them were registered with a Dairy Goats Association.

Mburu (2015), conducted a study on the effect of seasonality of feed resources dairy cattle production in coastal lowlands of Kenya. The objective of this study was to determine the effect of seasonality on availability and quality of feed resources on dairy cattle productivity in Coastal Lowlands of Kenya. A cross-sectional survey was conducted in Kwale and Kilifi counties on a random sample of 415 dairy cattle farms followed by a longitudinal survey on a purposive sample of 32 farms from the cross-sectional sample over a period of 12 months. Data from the cross-sectional survey was analyzed for descriptive statistics. Two-Step cluster analysis was used to classify small-scale farmers using variables selected apriori and identified four distinct clusters. The results from the study showed that dairy cattle obtained enough nutrients only in season. The crop-livestock production systems in study area were classified into four distinct clusters with distinct production characteristics. Productivity was low within all the clusters and was attributed to poor quality cows and inadequate forage whose availability was seasonal. The available forages were of moderate quality with average to high rumen degradability. There was a deficit in DM availability during the dry season which could be remedied through conserving excess feed during the wet season.

4.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

4.1 Introduction

This section presents results based on the objectives of the study. The results are on the extent to which dairy animal nutrition and animal health influences the level of milk production; also to determine the role played by animal hygiene in improving and sustaining milk production as well as the extent to which observance of animal welfare influences the performance of the cattle in terms of mil production.

4.2 Conclusion

The study concludes that animal nutrition is essential to animal health which in turn influence the level of milk produced. It was also evident that practices such as preserving water supplies and feeds from contamination, feeding animals on good quality feeds, ensuring there are good storage conditions of feed in the farm to avoid contamination and having quality assurance of feed supplier influence the level of milk production. The study further deduced that animal health to a very great extent influence the level of milk production. It was clear that detecting animal diseases early, preventing spread of disease among animals, ensuring there are mechanisms to prevent transmission of zoonosis and following correct treatment procedures whenever the animal is sick were aspects if ignored lead to deterioration of animal health and influenced level of milk production. On the topic of animal hygiene this study concludes that animal hygiene to a very great extent influence milk production. It was clear that use of suitable and well maintenance of milking and storage equipment, harvesting milk under hygienic conditions to prevent physical and microbiological contamination, practicing good milking routines and ensuring high cleanliness standards when handling the cows were aspects of animal hygiene that influence the level of milk production. Undergoing training on hygiene milk production and following good milking techniques also influence milk production.

4.3 Recommendations

It has become evident that the use of professional animal nutritionists to develop scientifically formulated, balanced, and nutritious diets to support milk production, while optimizing nutrient management programs and minimizing pollution is very essential in enhancing animal nutrition and subsequent health of the animal. However it is very costly and demanding thus most of the farmers are unable to acquire their services therefore this study recommends that nutritionists or ministry of livestock devise strategies on how to reach the unable farmers who desire to expand in dairy farming but are frequently faced with problems related to nutrition. The study recommends that the farmers should be trained on how to know the behavior of animals and their reaction to various circumstances as most of them lack these skills. From the findings, it was evident that farmers had mechanisms to ensure traceability and prevention of occurrence of chemical residues in milk therefore this study recommends that the effectiveness and reliability of these mechanisms be examined.

This study recommends that farmers should be trained on the importance of quality and not just the amount of production as most concentrate on the amount neglecting quality be it in milking or storage of milk. This stretches to quality assurance officers who should come up with strategies

that will enable them ensure that all producers comply with the quality and safety procedures throughout the process from production and collection to processing and distribution.

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