

A Holistic Review of the Kenyan Dairy Sector: Evidence for Transformative Interventions

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ABSTRACT

Kenya's dairy industry plays economic role both at household and national levels. It is one of the largest and advanced in the Africa continent. Despite the importance, the sector is characterised by low productivity and profitability. This is despite being one of the most supported agricultural sectors in terms of financing and research. We hypothesised that failure to approach the sector holistically limits the investments benefits. We further noted that the first step in designing dairy industry improvement programmes would be holistic review of the sector. This paper emanated from a study that undertook a holistic review of the Kenyan dairy sector for economic transformative interventions. The study provides evidence through multidimensional and non-sequential review of the sector. The study used explorative approach. Extensive interviews and systematic search of scientific publications complemented with grey literature search and review provided the necessary data or information used in testing our hypothesis. The findings indicated that the different dimensions of the dairy sector are mutually dependent and complex with numerous limitations. Dairy sector is not only technological but is also social in nature. The study recommends interventions that accurately describe the various dimensions of the sector. This is dependent on successful mobilization of key dairy value chain stakeholders through involvement of a versatile approach to adapt effectively to changing trends and transformative perspectives.

INTRODUCTION

Kenya's dairy sector, which private sector dominates, is one of the most successful and the largest in Africa (Rademaker et al., 2016). The sector is important to the country's economy as it contributes to rural livelihoods in addition to food and nutrition security. The sector contributes 4–8% of GDP with an approximate value of KSh 184 billion (USD 2.1 billion). The sector value chain comprises of input and services suppliers, farmers, transporters, traders, dairy farmers' cooperative societies, milk processors, distributors and retailers. Four themes that explain the dairy sub-sector are land size, wealth, commercialization, and degree of risk vulnerability (Otieno et al., 2016). His study further notes that subsistence orientation, inadequate capital, low quantity, and quality of land, inadequate skills and labour, inappropriate technology, and high risk prone

describe the Kenyan dairy sector. A smallholder dairy producer may or may not have all of those descriptors of smallness simultaneously.

Majority of dairy farmers are predominantly subsistent oriented and are yet to realize benefits from income due to informal market system participation.

As economic and production environments dynamisms increase, new opportunities and challenges occur and therefore the capability of subsistence in sustaining livelihoods drops.

The new environment characterised by increasing population, urbanisation, income, globalisation, policy changes, technology, food industry reform and climate change calls for transformation of subsistence farming.

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METHODOLOGY OF ANALYSIS

This study looked at the Kenyan dairy sector through explorative approach. The study used extensive interviews with industry stakeholders including farmers, government officials, and Non-Governmental Organizations (NGOs) during field visits. Through a systematic search, the study also reviewed scientific publications supplemented by grey literature. The source of systematic publications search was internet-based online search engines conducted in the year 2015 to 2020. The study followed the procedures for systematic literature search, as detailed by. The four main search engines used were Google scholar, Worldwide Science.org, ScienceDirect, and African Journal Online (AJOL). Search terms (keywords) used were dairy farming, dairy (cattle or cow), constraints (challenges or failures), opportunities, successes or sustainability, and Kenya. The study reviewed peer-reviewed journal articles, theses, conference papers, project reports, and government reports. Screening of all papers was by reading the titles followed by abstracts, and reading the complete paper if found relevant. The research also screened the sources of the listed publications in order to identify the related publications, which were significant but ignored by the search engine. Information extracts especially evidences or key messages from the papers formed the basis of this analysis [1-5].

RESULTS AND DISCUSSIONS

Production and Productivity

Results from the primary data collected during fields visits combined with that obtained from literature search, review indicated that zero grazing, open grazing, and tethering are the common grazing methods used in smallholder dairy production in Kenya. However, open grazing ranked highest among the grazed methods. In terms of productivity and profitability, zero grazing system ranked highest while tethering resulted in the lowest productivity. The data and information analysis further showed that milk production remains low based on production levels of the smallholders (who have smaller milking herd sizes) who are the majority in the sector. The farm size not only dictates productivity and profitability and support for the farmer's livelihood but also directs the economies of scale of the farm in accessing suitable and sufficient dairy inputs and markets. Identified output and production scale indicators include inputs, capital, credit facilities, and marketing orientation of the smallholder farmers. Most farmers have semi-permanent dairy-housing facilities across the different production systems. Overall, smallholder dairy farmers keep three dairy cows on an estimated 0.2 and 3 hectares of land. The farmers also have less than 15 years of experience in dairy farming. [6-10].

Results from this study indicated that land constraint is the principal limitation in dairy farming. This was previously reported by whose findings showed that the dairy sector is facing decreased land holding sizes. An analysis of the existing literature and primary data collected during this study indicates that land decrease for dairy activities is due to multiple factors

that include rise in human and cattle populations, expansion in urbanization, diversion of pastureland to cropland, soil degradation, and conflict for land use. Decrease in land sizes affects the dairy sector by reducing the amount of fodder available for milk production that results in an increase in production costs. The growing competing land use options pose a great challenge to dairy production according to a report by KDB (2019). The reduction in land sizes increases the problem of fodder/pasture availability for dairy cattle. Available land dictates, the size of the dairy stock kept, availability of dairy feed and the necessary amount of labour. Dairy farmers with less land access opportunities and those who depended on leased land are limited in their dairy business decisions to increase production and dairy enterprise profits. Conversely, a farmer who rent in land puts more emphasis on the short-term income. However, such farmers, who rented in land, are limited to specific land-based activities, including dairy infrastructure and mechanization, as they would exit the land upon end date of the lease term. Land area combined with ownership type influence the intensity, type of dairy system as well as the extent of the dairy production. The land could be collateral for financing as well, thus dictating the financial capacity of smallholder dairy farming [11-15].

Findings obtained in this study indicated that there is inconsistent supply of good quality and reliable dairy input in Kenya mainly due to low demand for inputs. Many big corporate companies dealing with dairy goods and services find it uneconomical to engage in the business due to the low demand. This results in increased cost of input resources due to unavailable smaller suitable economic packs especially for inputs such as vaccines. This gap is filled by small-scale business enterprises supplying the dairy farmers with substandard inputs. Most of the data analysed indicates that the principal suppliers of dairy inputs are agrovet stockholders, wholesalers, manufacturers, and distributors and is supported by the results presented by Auma (2019). Another important factor relating to inputs and which affects smallholder dairy producers in Kenya is the distance between the input suppliers and the dairy farmers which differed according to the location and which was further evidenced by the findings reported by Auma (2019). Most of manufactures are located in major cities, and the total distance between them and distributors varies between 200 and 360 kilometres. Major dealers and wholesalers are located between 100 and 200 kilometres from the farmers, while retailers are located between 5 and 30 kilometres from the farmers. These findings obtained in this study on the distance between the smallholder dairy producer and suppliers relate well with those reported by Auma (2019). It is noteworthy that advances in communication via mobile phones, availability of motorcycle transportation mode and mobile money providers has drastically decreased the prospective challenges relating to distance and trading costs associated with the availability and accessibility of dairy inputs. Results obtained in this study further indicated that although agrovet shops sell animal feeds and other animal nutrition related products directly to producers, it is strictly animal health practitioners who sell veterinary drugs, with the exception of tick control and de-worming products that are purchasable at the counter. Dairy feeds and volumes of

veterinary drug sales vary according to season, of which sales tend to increase during drier seasons [16-20].

Results from this study indicate that the smallholder dairy sector depends on finance and lending facilities in funding different production and marketing components. However, despite there being a variety of formal and informal credit services and providers, the accessibility of the dairy farmers to financial services remains poor. This emanates from the unwillingness of the financial services providers due to the high risk borne by the smallholder dairy producers. Many rural households cannot afford financial services (USAID-KAVES 2014). It is important to note that results show that the dairy value chain has credit arrangement supported by buyers; where large-scale processors fund dairy facilities, feed manufacturers, and veterinary drugs and services. Dealers of input providers advance the credit to their agents and retailers in form of goods and services. Dairy cooperative societies give credit (financial, services and products) to their members and recover the money from their deliveries of milk through a check-off system. Although financial institutions presently provide range of saving and credit schemes, it is important to increase the credit products accessibility. In addition to providing credit, finance and microfinance institutions also offer insurance cover. Findings from this study indicate that Kenya Commercial Bank, Barclays Banks, K-Rep Bank, Kenya Women Finance Trust-KWFT, Faulu, Rafiki, and Juhudi Kilimo are among the commercial banks/institutions providing formal loan products to dairy producers. Micro financial institutions and government financial institutions also provide credit to dairy farmers. Among them are Agricultural Finance Corporation (AFC), Agricultural Development Cooperation (ADC), Uwezo Funds, Youth Enterprise Fund, and NGO funds (e.g. One-Acre fund). Majority of these financial institutions provide unique and customized products and/or services to the dairy farmers. In addition, they advise farmers about better business decisions. Other common informal credit institutions identified from the data collected as well as literature information include table/village banking groups, formal and informal farmers' groups, relatives, friends, commission agents, input suppliers, and shopkeeper. Table banking and KWFT are accessible mostly to women groups [21,22].

This study finding indicate that the main barriers to lending include lack of leverage and the risk of losing property in case of a default, high interest rates, complex and complicated documentation process, short-term nature of credit demanded by financial institutions, and insufficient information about institutions and credit products. Literature analysis of previous institutional credit studies show that smallholders have limited access to institutional credit, mainly due to institutional constraints. On the other hand, large-scale dairy farmers have greater access to institutional credit because of their ability to manipulate funding outlets that find their high-value assets to be large-scale land holdings. Insufficient financial resources result to inadequate use of technology and poor dairy infrastructure. As a result, the costs of transactions are increasing because of the never changing operational activities. In the end, this slows production and marketing. Infrastructural factors affecting the smallholder dairy sector players are properties and equipment. This findings are in tandem with those obtained by Tuohy who

noted that farming assets such as feed cutters, knapsack sprayers, milking containers, treatment equipment, transport equipment, feed mixers, dryers, tractors or milk-cooling equipment and other related animal husbandry equipment owned by the farmer determines the competence of the dairy firm . The assets provide for the correct timing of the dairy decisions required, which differ from farm to farm [23-25].

Analysis of literature information and data obtained in the current study showed that the cost of farm and dairy infrastructure is a major hindrance to increased smallholder dairy production and profitability. The majority of smallholder producers are unable to invest at the farm level in the necessary dairy infrastructure. It was observed that some smallholder farmers who invested in equipment such as forage processing machinery face the problem of full capacity utilization due to their limited herd sizes something that had previously been reported by Tonderai. On the other hand, the advancement in information and communication technology infrastructure offers new opportunities for enhancing innovation support systems for the dairy sector. Effective communication system enhances the efficiency of all other components of dairy farming. In Kenya, many people use well-established mobile phone technology networks, especially mobile payment platforms such as M-Pesa, which facilitate cash transfers between individuals. The ICT infrastructure has made it possible to create dairy-specific applications that allow knowledge and information sharing. In Kenya, some integration of ICT in dairy farming is the first of their kind in the world. For instance, iCow is a system providing information to dairy farmers. Information on animal husbandry, animal diseases, and health management, information on market and trends through short text messages (SMS). This study finding indicated that smallholder farmers are using these communication channels to gain knowledge in production and marketing. Study by Irungu reported that use of the iCow model aided smallholder dairy farmers in increasing milk production and farmers' incomes through access to reliable production and market information. The second example is the the UNIFORM-Agri, an ICT platform created by the Kenya Market led Dairy Programme; KMDP innovation fund founded in Kenya to promote the selling of dairy farm management tools to farmers, cooperatives, and processors. Third example is the Agritrace, which is a Kenya Dairy Board; KDB Network is involved in the identification and traceability of national dairy livestock. Additional ICT services in the dairy sector include e-breeding, dairy web portals, e-dairy, e-commerce and mobile payment systems. While these measures are beneficial, their implementation and efficacy depend on factors such as technological efficiency, user friendliness, cost, and appropriateness in the dairy value chain [26,27].

Transportation is critical component in the dairy sector based on analysis of data obtained in this study since it acts as the linkage between input suppliers, producers, and processors. Milk being a highly perishable product also relies on the effectiveness of transport, particularly whenever long distances are involved. The form of transportation of milk depends on the form of the distribution route, the distance, and the amount of milk. On average, majority of the farmers are three kilometres away from the marketplace and milk collection centres. Farmers

report uneven infrastructure improvements even after heavy rainy seasons. Roads that serve some areas are also not accessible. This greatly influences the production and sale of milk. This is also reported by who found that poor road connectivity hinders the success of dairy farming. Input and output resources and their costs, market access, veterinary care and the training and transmission of knowledge required for dairy farming are all subject to transport infrastructure. In Kenya, majority of dairy farmers walk on foot when supplying milk to direct consumers. Customers also pick up milk directly from the farmers especially for short distances. Public service vehicles, motorcycles and, to a small extent, bicycles are used in supplying milk to vendors. The Bicycles and motorcycles modes of milk transport face multiple challenges, such as losses during rainy periods due to increase in accidents due to the roads being slippery resulting in low volumes being moved on per journey basis. This is besides the challenges the riders encounter in handling specified conductive milk containers[28].

Human resources and training are of the utmost importance for the successful operation of the dairy farm. Labour is a valuable factor, and its expense is second to the cost of feeding. In Kenya, large number of smallholder dairy farmers rely heavily on family labour. Labour demands for a dairy farm rely on a number of factors, such as the productivity of labourer, the species of dairy animals, the conservation of dairy stocks feed, feeding methods, the nature of animal housing, and the level of mechanization. Findings from the current study show that various forms of day-to-day work in a dairy farm comprise of feeding cows, watering and washing, cowshed care, cow health tests, cow milking, processing, and selling of goods. It was noted that dairy farmers with off-farm obligations are comparatively less likely to make decisions or work on dairy operations. There is a high variation in educational attainment of farmers. Farms in free markets perform differently depending on the managerial ability defined by a mix of individual knowledge, experience, and education [29].

Smallholder milk production is predominantly rain-fed and varies throughout the year, peaking during the long rain season from October to December. Unimproved natural pastures constitute an important source of dairy feed in smallholder production systems. The unimproved natural pastures mainly consist of a mixture of native grasses comprising of Kikuyu grass (*Pennisetum clandestinum*) and star grass (*Cynodon*). The Napier grass (*Pennisetum purpureum*) which is not native to Kenya is a key source of dairy feed in zero grazed system. Crop residues, particularly maize stover (*Zea mays*), are an essential food resource and are mostly obtainable on-farm since maize is a major staple food produced by households. Few milk producers' plant fodder trees mainly Calliandra (*Calliandra calothyrsus*) and herbaceous legumes for feeding lactating or in-calf cows. Although the farmers say that feeding dairy animals with the fodder tree resources results in more milk output, their usage is minimal. Most farmers have been unable to produce sufficient forage due to their limited land holdings and have to substitute forage collected from communal locations by means of hired casual labour or by buying forage such as hay, silage, agricultural by-products or crop residues obtained from them (Wambugu). The limiting land area is the primary obstacle for the production of feed in smallholder dairy farms. Importantly, the current

study findings show that forage seeds are costly and limited supply. Besides, certain problems include yield losses due to plant diseases. Kenya Agricultural and Livestock Research Organisation; KALRO, and the International Center for Insect Physiology and Ecology have produced a resistant strain of Napier grass called Ouma. KALRO also explores and grows alternate grasses, such as *Setaria* spp. and *Brachiaria* spp. The implementation of feeds technologies, such as haymaking and silage processing, remains limited given the extension and skills development on feed and grain budgeting. Information gathered in this study shows that Kenya has feed supply chain challenges. First, there is low and unpredictable consistency of the concentrates quality. Second are high feed costs. Third is the dependence on imported feed materials whose quality is not certain due to poor quality control systems. Fourth is the presence of commercial malpractices in the feed industry (MoALF) [30].

Dairy Breeding and Farm Management

Ayrshire and Friesian are the most famous and commonly reared dairy breeds in Kenya. Overall, the Ayrshire breed is preferred for the Friesian breed. Guernsey and Jersey varieties are similarly preferred. Usually, very few farmers select local breeds, with Sahiwal being the more favoured local breed. The main considerations in their order of preference are milk quality, milk fat content, disease resistance, low feed requirements, hardiness and short calving intervals. Market value and fertility are the most important characteristics. Friesian is excellent for milk yield, while Ayrshire is considered superior in terms of milk fat content, perceived resistance to disease and low feed requirements. Local breeds are hardy besides being tolerant to many tropical diseases.

Results indicate that most dairy producers in semi-intensive production system breed own bulls for use in their herds because of their relatively low cost and easy accessibility. Individual farmers own most of the preferred bulls. Artificial insemination (AI) is the most popular breeding technique used by the smallholder farmers practising zero grazing. This is mainly provided by private AI providers (because they are readily available) relative to the most popular government AI services. There is insufficient qualified in artificial insemination due to lack of equipment that is characterised by high cost. In addition, County and Subcounty livestock offices are mostly ineffective in controlling, supporting and providing artificial insemination services due to limited funding and lack of proper budgeting [31].

Variety of animal diseases is threatening the productivity and profitability of the smallholder dairy sector in Kenya. Animal diseases outbreaks remain a serious threat to the livestock sector in two ways: first is the huge economic impacts they pose and second is the negative impact of the measures put in place to curb the diseases. The diseases pose serious threats to the environment, animal welfare, public health, and the economy. Livestock diseases contribute to economic losses through increased livestock mortality, reduced productivity, control costs, loss in trade, decreased market value, and food insecurity. Thus, livestock diseases have major implications on livestock markets operation, household poverty, and livelihoods, due to the

diverse uses of livestock and the complex nature of the livestock value chain. Globally, the losses due to dairy animal mastitis amount to about 53 billion dollars annually. Severe economic losses due to livestock mastitis occur from reduced milk production, treatment cost, increased labour, milk withheld following treatment, premature culling and lethality and occurrence of other diseases. Brucellosis, lameness, mastitis, tick-borne diseases (heart water and yellow fever) and trans boundary animal diseases (foot-and-mouth disease and lumpy skin diseases) are significant dairy diseases in Kenya. Many dangerous diseases include anthrax, helminthiasis, infectious bovine pleuro-pneumonia, and Rift Valley fever. East Coast Fever is the greatest threat reported by dairy cattle producers as the primary cause of mortality. Changing climate often results in bad weather conditions, the emergence of animal health threats, and an unforeseen rise in outbreaks. Dairy death rate and low milk production are the primary economic losses incurred by disease outbreaks [32].

Animal protection requires immediate and critical consideration of the policy in the Kenyan dairy industry. Good care for animals is important, particularly in terms of improving the productivity of milk products. Lack of funding, low literacy levels, and small-scale land ownership are key factors influencing poor farming practices. There are presently no undertakings considered to work on improving animal welfare standards in Kenya. Nevertheless, a number of aspects of animal welfare are important for effective milk production. Animal health considerations include proper shelter, feed, irrigation, and diseases and veterinary support. As Kenya intensifies its export of dairy products, it would be important to pay attention to animal welfare because of a range of views on welfare of animals across countries [33].

Extension programmes have become the responsibility of county governments because of devolved and county governance (Auma). It has led to disparities in extension programme delivery across counties. Private businesses and non-governmental organisations (NGOs) such as One Acre Trust, Heifer International, and "Send a Cow" also provide farmers with extension services (Auma). Agroveter stockists mainly owned and run by animal health professionals also provide extension services to dairy producers (Auma). Local managers do provide farmers with dairy knowledge through public meetings (Barazás). Farmers have disseminated general information through publications such as radio, print, broadcast, and social media. Magazines like Seeds of Gold in the Daily Nation newspaper and TV shows like "Shamba Shape-up" and "The Organic Farmer" (TOF) are examples of public involvement in the dissemination of dairy information. Local dairy vendors, agricultural shows/fairs, and fellow farmers/neighbours/relatives also provide dairy information (Auma). Dairy information disseminated is from a variety of outlets, including home/farm tours, field presentations, trade visits, training workshops, office visits, and phone calls. Farmers usually seek guidance on general dairy husbandry, animal health/clinical/medical care, disease control, and reproduction, feed protection (silage and hay preparation), and routine husbandry practices such as deworming, spraying, AI, maternity detection, and vaccination (Auma). Farmers in all counties have shown a need

for expertise and skills in general dairy husbandry, milk, feed processing and feed collection, farming, and animal welfare (Auma) [34].

Dairy researchers and educational institutions (universities, technical schools, and KALRO) are conducting dairy science training and research. However, many are not adequately equipped and under-resourced. The Naivasha Dairy Training Institute has a dairy facility, a mini-processing factory, and a laboratory used in training students on dairy production and processing skills. In terms of research, there is a poor correlation between private dairy players and the research organisations including the universities. Proper research and working relationships between private sector and the government funded research organisations, on the other hand, would encourage the development and evaluation of more dairy products and services [35].

Farmers have a strong need for support and guidance in developing investment strategies and farm management practices. Besides, there is high demand for specialist extension programmes related to dairy products processing, which necessitates guidance on all aspects dairy production, processing and marketing. This can be achieved by establishing a strong team of agro-specialists in the local dairy farm sector has to deliver both technical advice and extension services to the smallholder dairy farmers households [36].

Dairy Marketing factor

Kenya's dairy farming sector has a low formal marketing force, with most milk being consumed at home with only a small volume being exported. Limited portion of the milk harvested is supplied to traders at farm gate, distribution to the nearest towns, or through milk collection centres many of which are not managed efficiently thus resulting to postharvest losses. Many smallholder dairy farmers sell their milk to cooperative movements, individuals and mainly neighbours for home consumption, dealers who transport the milk to the nearest towns, and dairy merchants who process the milk through pasteurisation and packaging. The choice of the smallholder dairy farmers to sell to a particular buyer is determined by the buyer's different considerations, such as level of farm production with farmers producing more milk opting to sell it through cooperative movements, improved credit terms, milk quality, affordability, legal contract, and information sharing. Low milk prices are the product of a long chain of the formal sector operating below capacity. The informal milk channel is slightly stronger in terms of consistency, but it is unreliable due to seasonal fluctuations.

The distance between farms and urban markets affects dairy farmers, especially smallholders, who benefit from rising demand for milk. The supply of production factors and the efficiency of demand for agricultural inputs and outputs are affected by distance to urban markets. Transport costs in Kenya are relatively high due to the poor state of rural roads in the areas where dairy production are undertaken. Bad roads lead to spills as well as spoilage caused by delays in milk supply to collection centres and processing plants (MoALF). Milk rejection by buyers is because of quality deterioration. Poor road

conditions also make it difficult to provide AI services as well as timely access to other dairy inputs such as extension services. The Government of Kenya, development partners, and the county governments should prioritise road network investment to promote growth of the dairy industry. Prospects for smallholder improvement lie in markets that allow for added value – reliable and steady production, higher commodity quality, and healthy products.

CONCLUSION AND RECOMMENDATION

The insightful findings of this study derived from the consolidated literature and primary data collected on dairy sector provide a multidimensional and non-sequential view of the sector as a roadmap to inclusive value chain growth for dairy products. The study notes that the different dimensions of the dairy sector are mutually dependent. Given the complexity and multi-related nature of the sector's obstacles, it is crucial that interventions by the dairy sector stakeholders concentrate on an accurate diagnosis of the various dimensions of the sector. Thus, addressing multisystem limitations that underlie dairy value chain development is urgent. Multi-stakeholder engagement is necessary for the sector improvement. Technological interventions and social commitments will therefore successfully mobilize key value chain and non-chain stakeholders and involve a versatile approach to adapt effectively to transformative the dairy sector over time.

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