

Review

Overview of dairy processing and marketing in East African dairy value chains: Opportunities and challenges

Michael N.I. Lokuruka

Department of Food Science and Nutrition, Karatina University, Box 1957-10101, Karatina and, PSC, P.O. Box 30095-00100, Nairobi, Kenya.

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Worldwide, the dairy sector is one of the fastest growing productive sectors. The global sector growth in the decade 2011 to 2020 is projected to be higher than that experienced in 2000 to 2010, mainly due to expected robust growth in developing countries. Global milk production in 2014 stood at about 800 million metric tons. India is the global leader in milk production accounting for 16% of output, with the USA coming second with 14.6% of global production, while Africa produces less than 10% of global output. Sub-Saharan Africa commands 0.2% of the global trade volume in the dairy sector. Egypt is the African Continental leader in milk output, as Africa remains the largest importer of milk powders, butter and ghee. The shortfalls in demand show potential investment opportunities and growth areas in the sector. The East African output of butter and ghee stands at about 15% of the African output of these products. Kenya and Uganda produce considerable amounts of processed dairy products, although, the milk processed rarely exceeds 12 to 15% of domestic milk supply, with most milk production being consumed at farm level. Tanzania produces more butter and ghee than other East African Community (EAC) members with Burundi been the least. Although, informal marketing channels, offering cheaper fresh milk are attractive, increasing decentralization of regulatory services, growing effectiveness of law enforcement and consumer awareness of the healthfulness of processed milk, will continue to reduce informal marketing of unprocessed fresh milk in EAC countries. Despite the quest for global export, the unmet domestic dairy products demand in EAC member states may slow entry into global markets. To meet the numerous requirements in export markets requires cautious, planned and systematic forays over time.

Key words: East Africa, dairy value chains, processing, marketing, opportunities, challenges.

INTRODUCTION

World and African dairy products status and outlook

Globally, the cow is the major source of milk and dairy products for human consumption. Worldwide, the dairy sector is one of the fastest growing food sectors both in terms of volumes output, sales and real commodity

prices. The global growth in the current decade 2011 to 2020 is expected to be better than that experienced in the decade 2000 to 2010, mainly due to projected robust growth in developing countries (FAO, 2012). The dairy products expected to exhibit real growth include fresh milk, cheese, butter, fermented products, skim milk

Table 1. Africa vs. USA Butter and Ghee Production (metric tons) in 2008-2011.

Country	2008	2009	2010	2011
Algeria	2295	2295	2295	2700
Angola	511	425	495	494
Burundi	131	124	152	218
Burkina Faso	1516	958	977	997
Chad	470	482	490	496
Egypt	125,300	127,600	127,600	127,600
Eritrea	1,391	1,399	1,421	1,438
Ethiopia	17,550	17,550	17,550	17,550
Guinea	8,000	8,200	8,800	8,800
Kenya	13,850	13,850	14,700	14,700
Morocco	26,127	27,523	29,200	33,522
Mauritania	967	1,039	830	852
Namibia	525	534	650	650
Niger	11,908	12,626	13,391	13,037
Nigeria	9,497	10,676	11,209	12,724
Rwanda	581	580	735	736
Senegal	572	643	703	711
Somalia	8,753	9,060	9,202	9,521
South Africa	11,790	11,925	12,120	12,400
Sudan (former)	16,176	17,793	17,010	17,010
Uganda	48	48	48	48
Tanzania	26,075	29,800	31,500	31,500
Total African Countries Production	284,013	295,130	241,077	307,704
USA production	745,613	713,269	709,406	820,898

Source: FAO (2011).

powder (SMP), whole milk powder (WMP), fresh whey and whey powder (WP) (FAO, 2008). Differences in regional and specific-country milk and dairy product growth patterns exist.

Global milk production in 2012 and 2014 stood at approximately about 800 million metric tons, while that from African countries stood at about 70 million metric tons for each of the two years (FAO, 2012; GoK, 2015), about 8% of global output. Some African countries that feature in the globalized dairy value chain are shown in Table 1. The global share of trade in dairy products by sub-Saharan Africa is less than 0.2% (FAO, 2011). One reason for this situation is the tendency to strive for self-sufficiency, the high cost of trade in dairy products often due to the perishability of dairy products and tariff and non-tariff barriers to free trade in world markets. India is the largest milk producer with about 16% of global milk output and its production includes buffalo milk. The US is the second largest producer accounting for 14.6% of global output, while Africa produces less than 8 to 10% of global production (FAO, 2011).

The predominance of low yielding traditional cow breeds, and the traditional, low-yielding goat, sheep and camel in African dairy value chains, contributes to the relatively low global percentage of milk output from Africa. Other factors including inappropriate feeding practices, poor herd management practices and technology gaps contribute to the low milk and dairy products output from Africa. Dairy products output reduce country outputs of milk, although, some countries may specialize in specific dairy products, some of whose raw material is imported, thus, distorting the milk and dairy products relationship. Africa versus USA production of butter and ghee in 2008 to 2011 is given in Table 1. It is noteworthy that for over 4 years, the annual butter and ghee production in the 22 African countries was approximated to be 34 to 38% of US annual production of these commodities.

East African dairy production: Status and outlook

Kenya is the largest milk producing country in sub-

E-mail: mlokuruka@gmail.com.

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Table 2. Milk production (metric tons) in EAC member states (2008-2012).

Country	2008	2009	2010	2011	2012
Burundi	22,000	26,000	30,418	43,836	31,800
Kenya	3,990,000	4,070,000	3,638,592	3,711,364	3,732,960
Tanzania	1,500,000	1,604,130	1,649,857	1,738,683	1,853,099
Rwanda	118,790	145,000	183,700	184,000	186,000
Uganda	1,120,000	1,155,000	1,190,000	1,190,000	1,207,500
Totals for year	6,750,790	7,000,130	6,692,567	6,867,883	7,011,359

Source: FAO-FAOSTAT (2008, 2011, 2012, 2013).

Saharan Africa with its cattle herd larger than all of the rest of East and Southern Africa, with dairying being the single largest agricultural sub-sector in the country (Staal et al., 2008). Kenya, Tanzania, Uganda, Rwanda and Burundi feature in that declining order for milk production as shown in Table 2. Despite Tanzania manufacturing more butter than Kenya. The higher butter manufacture in Tanzania is probably due to a higher consumption of full-fat milk in Kenya than in Tanzania. Dairy sector modernization in the East African Community (EAC) member states is identifiable with the introduction of high yielding exotic dairy breeds, increasing use of artificial insemination and other artificial reproductive technologies, supplementary feeding and general improvements in dairy herd management practices including the adoption of zero-grazing and better disease control strategies.

In all East African and some Horn of Africa countries including Sudan, South Sudan, Somalia and Ethiopia, there are indicators of real growth in the livestock sector as shown by increasing herd numbers, increasing milk output, improvements in herd health, diversification of processed dairy products and increasing high value dairy products in intra-Africa trade. In this regard, Kenya continues to raise its output of milk from cow, goat, sheep and the camel through dairy policy amendments, research in new feed and feed formulation approaches, breeding for higher milk yields, better disease control, and general extension service improvements. The devolution of agricultural services in Kenya to Counties is expected to lead in the long-run to better law enforcement and therefore an expected reduction in the quantity of milk being hawked in urban areas. Most of Kenya's milk production is estimated to be consumed at the farm level and most of it bought in raw form, and only about 12% of production is processed for the formal market (Kenya National Bureau of Statistics, 2009). The country has intensified its export of dairy products to Uganda, South Sudan, Rwanda and the Democratic Republic of the Congo (DRC). Uganda also continues to raise its milk and dairy products production and exports of dairy products to Kenya, South Sudan, Rwanda, eastern DRC, Tanzania and Mauritius. Despite the increasing export of dairy products by EAC member states, local demand for dairy products is not fully met. It

may be easier to deal with internal markets than with international market dynamics for reasons related to the myriad of requirements that an exporter has to meet before they can export, even to neighbouring African countries. Politics may some of the time create non-tariff barriers for the export of dairy products. While Kenya's annual milk production stood at about 4 billion liters, Uganda, Tanzania, Rwanda, Burundi produce about 1.2 billion, 1.5 billion, 186 million, and 31 million litres, respectively by 2012 (FAO, 2013). The goat is replacing the cow in Burundi due to shrinking farm sizes and having the highest human population density in Africa (up to 400 persons/square kilometer) (FAO, 2013). The shrinking land sizes and increasing human populations are both challenges, but may also be opportunities with regard to the use of intensive production systems to raise milk production, improve the quality of milk and dairy products and the overall efficiency of the production system, through application of modern herd management practices and technological adoptions on-farm (Owen et al., 2005). Some challenges facing the dairy sector in EAC member countries include: the management of farmers' cooperatives, adequacy and the quality of feeds, herd management practices (animal housing, supplementary feed cost, adequacy, availability, timeliness, cost of veterinary extension services after liberalization of the dairy sector, and the cost of credit facilities from financial service providers). In Rwanda, Burundi, Somalia and parts of Kenya and Uganda, land use rationalization may eventually lead to adoption of zero grazing (in Rwanda, Burundi and Somalia) and further intensification of its use (in Kenya, Tanzania and Uganda) in order to meet the demand for livestock products by the growing populations. The growing scarcity of agricultural land and the need for the pastoralist system to continue supporting herd numbers of livestock will further increase the pressure on land; this is likely to lead to increased land degradation resulting in the inability of the natural regeneration capacity of pasture, to meet livestock requirements in East Africa's extensive production system-this may lead in future to the severe constraints in pastoral production systems. The expansion of physical infrastructure in the form of road networks, railways, institutions and human settlements

will compound the availability of land available for sector growth.

Dairy products processing: Opportunities and challenges

The most common outputs from milk processing generally include fermented products, skim milk, cheese, fresh and ripened cream, fresh whey, butter and ghee, skim milk powder, whole milk powder, ice cream, whey powder, casein and lesser derivatives of whey. While the level of technological development of the dairy sector in a country influences the nature of dairy products that are derived from milk processing, local demand or export demand, determine the derivatives of the local dairy industry. The size and the complexity of the dairy industry in a country largely determine the nature and amount of dairy products in the local dairy value chain. In most African dairy sectors, the most common derivatives of milk processing include pasteurized and long-life milk, cheese, yoghurt, fresh fluid whey, butter and ghee, and on a smaller but increasing scale, skimmed milk. The increasing demand for the latter is due to perceived benefits to human health of the consumption of reduced amounts of saturated fatty acids in diets (ISSFAL, 2004; Lokuruka, 2007).

Opportunities in dairy processing

Dairy technologists and dairy scientists, food technologists and animal production scientists contribute to the expansion and technological advances in the dairy sector and therefore, impact positively on the quality of the contribution of the dairy sector to a country's economy. A number of east African universities offer degree courses in Food Technology, with degree courses in dairy technology being increasingly offered in the same institutions. The oldest department of dairy technology at Egerton University in Kenya has since the 1960s continued training a large number of dairy technologists for the East African region and beyond, including central, Southern Africa and the Caribbean. Most dairy factories in the East African region process pasteurized milk, yoghurt, cheese and long life fluid milk. The demand for dairy products presents opportunities for job creation along the dairy value chain, for increasing farm incomes and for value addition through processing and sale of products to domestic and export markets. In small scale and unregulated dairy industry, as is observed with dairy cooperatives, whey and its ingredients are either given to calves or are let out to pollute the environment, a practice that is increasingly coming under scrutiny in an effort to take care of the environment, cut down on wasteful resource disposal and maximize social and economic value from available animal resources.

The further processing of these by-products of dairy processing, presents opportunities for value addition of what would normally go to waste in undeveloped dairy value chains. Whey can be dried further by water removal to allow recovery of casein, minerals and vitamins from the stream. In Africa, only the Republic of South Africa produces some whey dry powder. Some dairy by-products are part of the increasing range of minor food ingredients referred to as functional foods. Functional components in foods confer both functional properties in food processing as well as nutritional benefits to consumer health. In dairy foods, the functional ingredients include milk lactoferrins, immunoglobulins, peptides from milk protein hydrolysis, fatty acids such as conjugated linoleic acid (CLA), oligosaccharides and melatonin (De Wit, 1998). By-products of whey and the functional ingredients of dairy "waste" streams have industrial applications and value. These nutrients can be exported to developed countries for use in the pharmaceutical industry and as ingredients in high value food product preparations if they cannot be value added in developing producer countries. Condensed whey concentrate can be made from whey to take advantage of its potentially low cost and good nutrient profile. This potential product from whey processing can be turned to human food and animal feed in East African dairy value chains. As low yielding dairy cattle and goats predominate in East Africa, there is room for genetic breeding of high yielding milk animals. Although, semen importation mainly from the US and recently from the Republic of South Africa to improve the Kenyan dairy herd has been ongoing over many years, it has not translated into marked increase in milk output. This may be attributed to the unfavourable contribution of other factors that combine with genetic potential to influence the expected higher milk output, including feeding practices. Nevertheless, genetic breeding for high milk yield is necessary and recommended for dairy farmers (especially those on zero-grazing systems) and for government dairy experimental stations. These research stations serve as demonstration units and sales points for improved dairy animals to farmers.

Improved milk output reduces importation of dairy products thus, sparing foreign exchange and making more milk available to citizens thereby improving the nutritional status especially of poorer clients and farmer households, whose source of protein may often be milk as meats would be out of their reach due to their higher purchase prices. Further sector investment should focus on feed manufacture, artificial reproductive technology use, chilling facilities, cold transportation facilities and the manufacture of specialty dairy products for niche markets. As African and East African populations and economies grow, the demand for milk and dairy products will increase and the opportunities for more jobs and prosperity will result. The niche markets include high-end tourist hotels and hotel chains that import dairy products

from Europe or the US for foreign visitors to the EAC member states. The substitution of imports by locally manufactured dairy products will save foreign exchange, create employment through small and medium industrial dairy concerns, thus, supporting industrialization in EAC member states. In Africa, only the Republic of South Africa, Zimbabwe and Kenya in that declining order produce WMP (being 0.8% of World production of WMP) (FAO, 2011).

Challenges in dairy processing

Milk processing at an industrial scale is severely limited in Africa partly because dairy processing machinery is imported mainly from outside the African continent, and is expensive. In countries where commercial dairy processing plants have been set up, only a few dairy products are produced, sometimes, due to the lack of appropriate handling and processing technologies and the shortage of knowledgeable experts to manage the industry, professionally. When dairy scientists/technologists are available, managerial expertise may lack. The lack of technology may also combine with the lack of market, an unstable market or a market located far away from the site of processing plants, to curtail processing capability. Long distance to market raises the price of dairy products making them out of reach of the poorer members of society for whom this nutritious food would be appropriate. In most dairy processing industries in Africa, skim milk powder or whole milk powder tend to be expensive to produce and are therefore mainly imported to meet unmet domestic demand for fluid milk. Lack of milk chilling facilities to cool milk enroute to market, or while waiting collection, may also discourage production and therefore curtail dairy products processing, and the outlay of a diversified product portfolio. As dry milk powders are mainly imported by the EAC member states, reconstituted milk made from dry powders tends to be expensive for the average consumer and this may limit milk and dairy products consumption; Industrial energy tends to be expensive in Kenya and relatively so in most East African economies thus, affecting the price of processed dairy products, accordingly. Nevertheless, there is no absolute certainty that local production of milk powders may be cheaper in view of the low milk volumes available, and the expense of importing expensive machinery, whose maintenance costs are prohibitive. Some challenges faced by processors include low milk deliveries to processing plants resulting from low production or low investment in processing capacity. During times of glut, low processing capacity means that the processor cannot take advantage of periods of high production, often leading to wastage (milking is not done and calves are left to suckle continuously, while at the other extreme, milk is left to spoil and is eventually poured out). This situation can lead to depressed prices

to farmers which can discourage high production. As glut often leads to low prices to farmers, low producer costs rarely translate to low consumer prices. In situations where investment in feed manufacture by local entrepreneurs is low, recommended animal feeds are imported and this tends to raise production costs. The high milk production costs are not compensated by higher payments for milk delivered to processors. Low prices or delayed payments often encourages the farmer to sell in the informal markets which pay on delivery as opposed to having to wait for the processor to pay after selling processed products in the formal markets. The incomes from selling milk to hawkers are thus higher for farmers and the prices to consumers may be lower (Thorpe et al., 2000). Hawking raw milk in informal markets continues to plague the Kenyan dairy value chain and the scenario may be similar in other EAC member states. Sometimes, the quality of the available animal feed is low, influencing animal production accordingly.

Dairy products marketing: Opportunities and challenges

Opportunities in dairy products marketing

It is a good practice that dairy factories are located near or in dairy farming areas; also, the nearer the market is to dairy processing factories, the lower the end product transportation and haulage costs. Low product haulage costs mean low product prices to consumers. Good infrastructure in the form of good roads and rail, potable water and extension services are necessary, if the cost of product handling has to be as low as possible, as the quality of infrastructure influences the ease of transporting raw materials from farm to factory and finished goods to market (Owen et al., 2005). Adequate and good quality water for food processing is critical for good quality end product and therefore its shelf life. The shorter the distance covered by the marketing team to deliver products to market, the higher the quality of products reaching customers and vice versa. Although, competition between fresh milk of different milk species is normally non-existent, the preference for cow milk is almost universal in East Africa except with the Hindus, for whom a cow is deity and who therefore do not consume its milk. However, there are ethnic-based differences in dairy products acceptance arising from familiarity with the dairy species.

Most pastoralist ethnic communities of East Africa accept milk from camel, goat, sheep and cow, but the acceptance of camel milk by non-pastoralist communities living in urban and/or rural areas is generally low, and the sale of such milk requires niche marketing, targetting mainly former nomads who have settled in urban areas. This scenario tends to discourage the expansion of the dairy industry based on other milks other than cow milk.

The location of the plant in a neighbourhood can provide employment opportunities and encourage dairy farming in a locality. Other areas of potential opportunity include the increasing decentralization of regulatory services, the growing effectiveness of law enforcement and consumer awareness of the healthfulness of processed milk. These factors will generally continue to impact positively on the marketing of processed milk and lead to a reduction in hawking of unprocessed milk through informal channels in East Africa and other developing countries. However, law enforcement is a necessary additional tool if the informal marketing of raw milk by hawkers has to be discouraged.

Challenges in dairy products marketing

Common challenges faced by small scale dairy farmers include long delays in payments for milk delivered to processing plants, and long distances covered by farmers over poor roads to dairy processing plants. Others include low investment in chilling plants which affects the quality of farmers' milk resulting in rejection of considerable amounts of milk and low prices of milk delivered to factories compared to prices offered by hawkers and on-farm buyers of fresh milk. The low uptake of credit facilities by farmers and small scale processors due to their risk averseness, the impact of the multiplicity of collateral requirements for financial assistance, impacts negatively on dairy sector development (World Bank, 2011).

Legislative hurdles in international marketing of dairy products

Despite the allure of international markets, penetrating them is not as easy as may be perceived.

Food trade is regulated by statute. Regulatory agencies in importing countries generally issue licences to importing entities to apply for it at a fee. Normally, there are specific licences for specific foods and sometimes different licences are needed for the same food type depending on the state of the food; for example for processed fluid milk and processed frozen milk, different licences may be required to export them. Foods are also traded under specific agreements which may specify the manner of handling, quantities, the timing of deliveries, etc. but generally, the procedures follow the provisions provided for in the applicable laws. It is advisable for importers and exporters to know the applicable statutes and the manner of engagement of parties in trade transactions for successful and long-term engagement. Milk and dairy products are some of the most controlled commodities in food trade as far as quality assurance and food safety is concerned. Normally, all imported foods are subject to inspections by regulatory agencies

and can be "held" until tests show compliance with applicable importing country laws before they are allowed into market on authority of the regulatory authorities. Fulfilment of regulations for mandatory documentation at the point of entry is normally required before testing is done.

It is thus critical that proper procedures as necessary to obtain the appropriate documentation are followed to avoid economic losses and penalties that may be imposed in case of irregularities. An import permit or cargo clearance permit is usually the first document required at the point of entry before the food goes for testing for "fitness for purpose". It is therefore incumbent upon traders that they apply for the required documentation prior to the export of dairy products, besides meeting other legislative and food handling requirements, some of which may be dairy product-specific. For processed dairy foods, ensuring that the dairy product is produced in a regulated environment is mandatory; the environment must be one in which food is under the regular surveillance of the competent authority in the exporting country (Lokuruka, 2011). In the case of Kenya for exported dairy food, these agencies include the Kenya Dairy Board, Kenya Bureau of Standards, Ministry of Health and the Department of Veterinary Services (Lokuruka, 2011). A private quality assurance agency such as Bureau Veritas may be employed by the State Regulatory Agency or the exporter to enforce quality specifications and the appropriate environmental conditions at processing. Providing documented proof that the dairy food is produced under a regulated environment is often assumed as proof of being able to produce safe and quality-assured dairy product for export. Where feasible, sending advance products for quality and safety testing in certified laboratories in the importing country saves time and money. The use of permitted additives and preservatives in dairy products for export should be confirmed with the importing country regulatory agencies. These can differ by country and is therefore prudent for the dairy trader to have this knowledge by country and dairy product type.

Food safety concerns in global dairy foods marketing

Besides local and regional markets, international markets are potential outlets of dairy products from the EAC dairy value chains. Due to the unique nature of requirements for marketing food in international markets, an examination of the intricacies of marketing dairy food in international markets is important. The mobility of people and animal foods around the world carries risks associated with the increase and transfer of zoonoses across the globe through food trade; some recent concerns in this regard include salmonella, avian flu and prions. The use of recommended antibiotics, good hygiene practices, and vaccines to treat animals are

safeguards to keep zoonoses in check. Food importers or regulatory agencies in importing countries most often will test for levels of certain indicator microorganisms like salmonella in animal foods or foods in which animal foods are ingredients and for chemical residues such as antibiotics in dairy products. The use of recommended safeguards in a country's animal food industry within the agreed and recommended international protocols is likely to increase a country's exports of the respective food commodity around the globe.

Today, countries are setting disease-free zones, certified testing laboratories among other requirements as safeguards to maintain and improve food safety. Often, the consumer needs to be assured that the food handler is cognizant of food safety and quality right from the farm. It is prudent to demand zero tolerance of any suspect undesirable potential agent in processed dairy foods; due diligence at all stages of the dairy value chain and the practice of good hygiene practice (GHP) and good agricultural practice (GAP) are recommended for food safety assurance to succeed. This may mean surveillance on the farm, prudent use of pesticides according to manufacturer's instructions and the use of "safe" chemicals as certified by the Ministry in charge of Agriculture and Food (Lokuruka, 2011). However, no "absolutely safe" chemical is available as far as food production and processing is concerned; any chemical will normally for all practical purposes have some undesirable effects on humans, most of the effects being long-term (Lokuruka, 2011). Of importance in this respect is the quantity of the chemical or processing aid used in food and the conditions of food handling and processing; these factors determine the amount and nature of the potential residue in the end product.

To-do and not-to-do basics in international dairy foods trade

For anybody wishing to engage in international trade, it is prudent to consult with prospective customers, and agents in the destination market so as to determine the best strategy for selling products in the market. Studying competing products in the country where you wish to do business is a good way to know what is available and works in that market. Such a search can open a niche for your product. Products for export are invariably packaged and therefore some basics that you have to ensure are in your product package include:

1. The name of product: Choose a name and understand its misconceptions and other hidden meanings in the destination markets.
2. The colours of the package: Understand what the colours you choose for the package may mean whether implied or real in the market where you intend to sell your product.

3. Packaging and labelling design: Besides your colour choices, your illustrations or graphics need to be appropriate, appealing and understandable to your product end-user. If you want to sell your products in stores that scan data, bar-coding your product will be essential.

4. The size or quantity of product: A designated volume/size or quantity might be perfect for one importing market or even in the country of origin according to country patterns of consumption, but it could be way too much in another. If too much of your product will go to waste, it is not economical or convenient for your consumer, and it is likely that they won't buy it again. So it is prudent to check average consumption volumes or weights and sizes before you decide how much product to fill into your sales/retail package.

5. Weights and measures: You should use the weights and measures that are applicable in the country where you desire to sell your product.

6. The language on the package: The labelling on the outside of the package in the language of the importing country is mandatory. The label or sticker should state the common name of the product, the importing agent's name and address, the weight of the package in the importing country's standard units of measurement, an appropriate ingredients legend, an indication of suitable storage conditions and the expiry date.

7. Pictures of your product on the label: A picture tells a thousand words. Illustrations are acceptable, so choose only those that are suitable and portray good meaning when associated with the product you want to offer in the sales market.

9. Packaging material: If your packaging is behind the times in the importing country, don't think you will be able to unload it in the world market. Customers worldwide appreciate innovation and cutting-edge technology, and they EXPECT it to be show-cased for imports anywhere.

10. Handling warranties, guarantees, consignment sales or service calls overseas: Anticipate what it will take to put one of these commitments in place globally. If it is not feasible, then do not offer it as the market may not be friendly to your product for long no matter how good, affordable and convenient it may be.

11. Environmental effects on your product: Humidity, extreme hot or cold temperatures, poor infrastructure, etc. all can affect how your product holds up in a new market. So choose a market that is a better fit for your product.

Adapting products to meet the needs of an international market is a considerable undertaking, and will most likely require a substantial investment of both time and money. It will be smart to determine if the anticipated sales will outweigh the expense, and to project how long it will take to recover your product adaptation costs. If they are not favourable, do not attempt it and instead choose to work on the local market or neighbouring country-markets.

Conclusion

Although, the EAC countries do not currently meet domestic milk and dairy product consumption requirements, there is room for export of surpluses to international markets. Farmers in EAC member states have the potential to generate surplus milk for export, but the milk should be of the highest quality in order to produce high quality processed products; National governments should strive to provide the required infrastructure, create policies that encourage investment in the dairy value chain and support universities to conduct appropriate dairy research and produce adequately trained manpower for the dairy industry. Local/County Governments have the responsibility to provide potable water for high quality dairy processing, encourage implementation of appropriate trade policies and adequate extension services in a bid to raise production.

The provision of appropriate extension services by government agencies can keep dairy products affordable. Processors on the other hand will be required to make adequate investment in processing capacity, fabricate appropriate processing machinery, and pay fair prices to encourage higher milk production by farmers; it is partly the responsibility of regulatory agencies to provide appropriate and timely market information to the dairy sector as they improve law enforcement in order to improve quality and hygiene in the dairy value chain. To succeed in export, trade requires up to date knowledge of legislative, food safety, packaging and marketing requirements of the importing market and knowledge of the competing products in the destination market. In well-structured, organized and functioning EAC dairy value chains, farmers, processors, traders and Governments can reap maximum benefits and contribute in the long-term to GDP growth and nutritional well-being of countries' populations.

RECOMMENDATIONS

In order for the EAC dairy sector to grow steadily, the author recommends the adoption and implementation of the following:

1. Investment in the training of dairy scientists, technologists, food engineers and Business managers. The opportunity of fabricating machinery locally by trained and resident food engineers can reduce the cost of machinery and save on foreign exchange. Management expertise is necessary for the appropriate and professional management of the dairy business as the application of science and technology alone is not adequate to run a business concern profitably and professionally.
2. Improving production and milk quality at farm level-by

providing quality feeds, ensuring affordable credit facilities are available, and improving management practices at farm level-through appropriate extension training, good animal housing, animal health and feeding; zero grazing is a management/production practice that the author recommends for intensive production, though it may be expensive to implement and maintain.

3. Installing preservation technologies at farm level and preserving milk and dairy products in transit and along the value chain (it may be desirable to form cooperatives to enable economies of scale at milk collection and transportation when the factory is far from the farming area and milk collection points); the provision of chilling facilities along the value chain is absolutely necessary, even on a small scale, due to the perishable nature of milk and dairy products.

4. Regulatory control and provision of market information-extension services and veterinary services for quality product marketing and animal health, respectively, are necessary for a functional and progressive dairy sector. Appropriate policy direction and plans are necessary and should be provided by Government and its agencies.

5. Investment in renewable green energy sources for sustainability of energy supply. This is bound to bring down the cost of industrial energy which currently curtails production and inflates pricing to consumer disadvantage resulting in low returns on investment to entrepreneurs in both the dairy and energy sectors. The investment and utilization of green energy sources is also likely to cut down on the use of fossil fuels for energy generation and make investment in the dairy value chain attractive. The development of green energy technologies is suitable for rural areas where it may not be cost-effective to use electrical energy from the national grid due to the low usage potential arising from low populations and low incomes profile of would-be consumers.

6. Enforcing cost-effectiveness and export requirements-Where exports are contemplated, compliance with dairy food safety, packaging, marketing and other regulations should be strictly adhered to as required by the importers and as specified by the local and international applicable statutes. Profitability is assured only when full knowledge of the cost-revenue structure of the dairy business is available, known and when critical non-financial demands of the consumer are met fully.

Conflict of interest

The author declares that there is no conflict of interest.

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