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Milk Production in Tanzania

Supervisors: **Dr. Ferenc Pajor, Associate professor**

Author: **Henry Mokiwa**

Neptune ID: **Z11Y4B**

Institute/Department: **Institute of Animal Sciences,**
Department of Animal Husbandry and Animal Welfare

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ABSTRACT

Milk production in Tanzania

Henry Clement Mokiwa

Course, level of education: Bachelor of Agriculture Engineering

Host Department/Institute: Institute of Agronomy, Hungarian University of Agriculture and Life Science, Szent Istvan Campus

Thesis advisor: (Name, position, institute/department)

Independent consultant: (Name, position, institute/department)

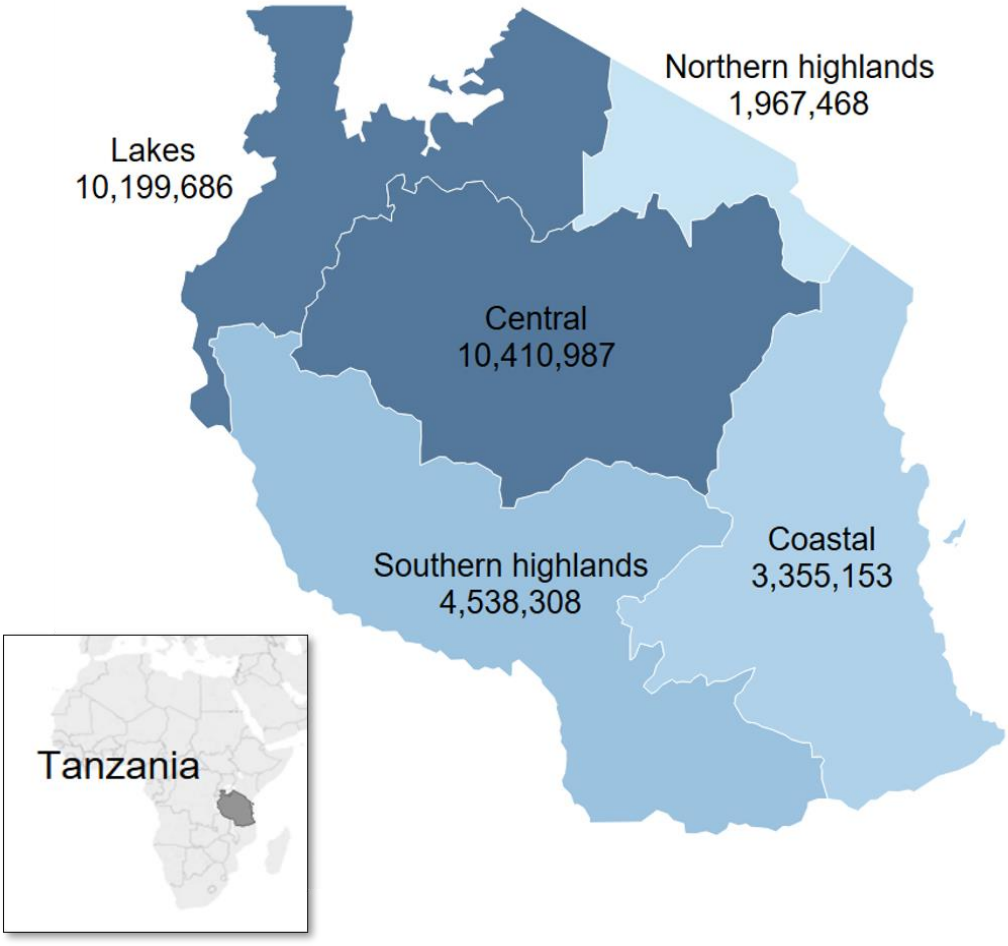
This abstract explores an overview of a thesis study on milk production in Tanzania on how the potential for increasing milk production in Tanzania, focusing on enhancing both the quality and quantity of dairy output to improve the livelihoods of livestock keepers and contribute to the nation's economy, Despite having a significant cattle population, Tanzania ranks low in global milk production, primarily due to challenges such as seasonal variability, disease prevalence, and inadequate management practices. The study aims to identify low-cost strategies that can be implemented in the short to medium term to boost productivity within the dairy sector. By analysing current trends and historical data, it is projected that Tanzania could produce approximately 3.38 million metric tonnes of milk by 2031, reflecting an annual growth rate of 3.44%. The research highlights the importance of improved breeding techniques, better feed quality, and enhanced management practices as critical factors for increasing milk yields. Furthermore, it stresses the role of smallholder farmers in the dairy value chain and advocates for cooperative structures to enhance market access and bargaining power. The findings suggest that with targeted interventions—such as promoting artificial insemination services, improving animal health care, and fostering consumer awareness about the nutritional benefits of milk—Tanzania can position itself as a competitive player in the global dairy market while simultaneously addressing food security and economic development goals. This study uses secondary data from various sources, including FAOSTAT, Tanzania dairy reports, and global milk production data, and other data was collected from Rungwe District, Tanzania as primary data, the study assesses the effectiveness of improved feeding practices, including hydroponic fodder systems and pasture management, as well as health and hygiene practices to identify areas for improvement.

1. INTRODUCTION

1.1 Study area.

Tanzania is in East Africa, boarded by the Indian Ocean to the east, Kenya and Uganda to the north, Rwanda, Burundi and Democratic Republic of the Congo to the west and Zambia, Malawi, and Mozambique to the south. The country includes the islands of Zanzibar, Pemba, and others in the Ocean. Tanzania is known for its diverse geography. It is also home to several national parks and wildlife reserves, making it a popular destination for ecotourism and wildlife viewing.

Figure 1; The cattle population in the Tanzania *(CSIRO, 2020)*



One of the healthiest foods available is milk, which has a high protein content that includes all 10 essential amino acids. It also has good amounts of calcium, vitamin B2, vitamin A, and a fair amount of vitamin D_3. Tanzanians currently consume 40 litres of milk and milk products year on average, which is far less than the 200 litres recommended by the World Health

Organisation (FAO, 2019). For dairy producers, dairying offers one of the fastest rates of return. In addition to giving farmers—particularly women—regular income flow from milk sales, it also improves household nutrition and food security, generates off-farm work, and supplies milk for domestic consumption. Dairy cows are among the most precious resources for rural Tanzanian communities. households serving a variety of purposes, including risk management, nutrition value, and traction. Within the cattle sector, the dairy industry has been chosen as the primary focus for expansion and investment. The primary goal of the policy is to raise milk output by 77% by 2022, which will result in a 1,002 million litre milk surplus above the expected domestic milk demand. This excess milk might be exported as UHT milk or powder to increase foreign exchange earnings, or it could be used locally for new and additional industrial uses, therefore reducing the nation's reliance on imported milk products. Dairy animals currently have poor productivity levels that are heavily influenced by seasonality. For instance, the typical milk yield per cow is between 0.6 and 0.8 litres. day in the traditional systems during the dry and wet season, respectively, and from 6.5 to 12.3 litres per cow per day in improved systems during the dry and wet season, respectively. Milk yields are low and largely variable mainly because of poor and limited feed availability, disease and poor management (Stapleton et al., 2017).

1.2. Objectives

To identify and evaluate low-cost option that Tanzania can implement in the short to medium term goal towards improving productivity in dairy cattle production system, high quality and quantity of milk which recognized international and fostering economic development to Individual Livestock keepers, Milk processor and the Country by being among the best hub for quality and quantity of milk producer, sufficient of milk in a country and contributor in the world.

2. LITERATURE OVERVIEW

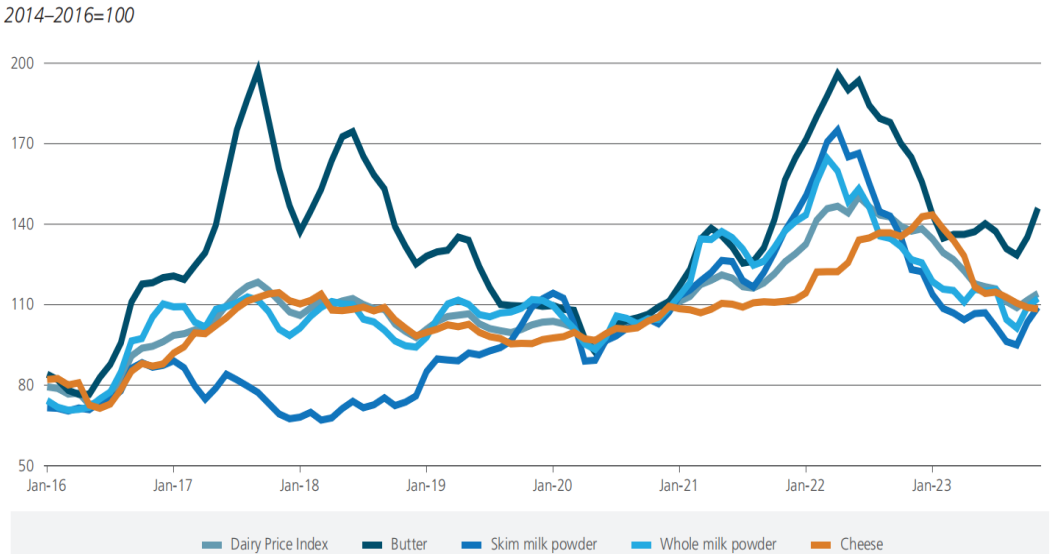
2.1 Global Milk Production

The global cattle population amounted to about 942.63 million heads in 2023 up from approximately 940.37 in 2022 (*Cattle/Cow Population Worldwide*, n.d.).

Over the past 50 years, there has been significant growth in the world's milk production; as a result, since 1961, the world's milk output has quadrupled, reaching 918 million tonnes in 2021. Cow milk is the most widely consumed type of milk, followed by camel, goat, sheep, and buffalo milk (Ritchie et al., 2024). Approximately 150 million families worldwide participate in milk production, in most developing countries milk is produced by smallholders, and milk production contributes to household livelihoods, food security and nutrition Milk provides relatively quick returns for small-scale producers and is an important source of cash income(*Milk Production | Gateway to Dairy Production and Products*, n.d.).
In recent decades, developing countries have increased their share in global dairy production. This growth is mostly the result of an increase in the numbers of producing animals rather than a rise in productivity per head. In many developing countries, dairy productivity is constrained by poor-quality feed resources, diseases, limited access to markets and services (e.g., health, credit and training) and dairy animals' low genetic potential for milk production. Unlike developed countries, many developing countries have hot and/or humid climates that are unfavourable for dairying (*Milk Production | Gateway to Dairy Production and Products*, n.d.).

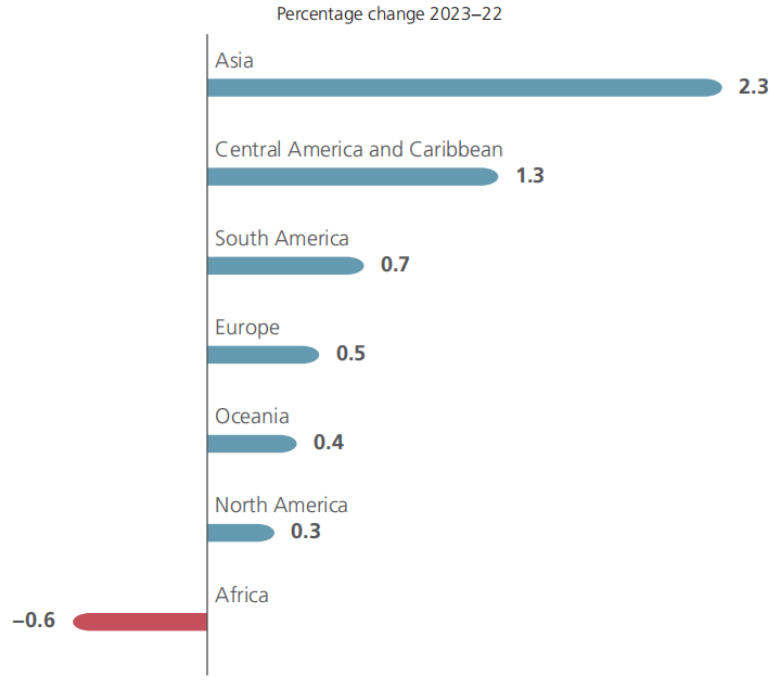
Some countries in the developing world have a long tradition of milk production, and milk or its products have a significant role in the diet. Other countries have proven significant dairy production only recently. Most of the former countries are in the Mediterranean and Near East, the Indian subcontinent, the savannah regions of West Africa, the highlands of East Africa and parts of South and Central America. Countries without a long tradition of dairy production are in Southeast Asia (including China) and tropical regions with high ambient temperatures and/or humidity(*Milk Production | Gateway to Dairy Production and Products*, n.d.).

Figure 2; FAO Dairy Price Index (FAO Dairy Price Index, n.d.)



Global milk production in 2023 is likely to reach 950 million tonnes, an increase of 1.3 percent year on -year a foster pace compared to the 0.6 percentage growth registered in 2022, principal driven by volume growth in Asia, specifically in India and China, with moderate growth in the rest of the world and potentially lower production in Africa (Dekermendjian, n.d.).

Figure 3; World milk production by region (Dekermendjian, n.d.)



2.2 History of the dairy industry in Tanzania

Large estate owners controlled the dairy industry, which included dairy farms and processing facilities, before 1961. The industry was governed by three Zonal Dairy Boards from 1961 to 1965. Specifically, Mara Creameries for the Mara Region, Coastal Dairies for Dar es Salaam and Coast, and Northern Dairies for Kilimanjaro and Arusha. These Boards were tasked with opening and operating dairy farms and milk processing facilities, grading milk and its products, manufacturing, processing, and marketing milk and its products, and obtaining milk and milk products from farmers. Act No. 61 of 1961 (Cap 456) was repealed in 1965 when the National Dairy Board was proved by a parliamentary act known as Act No. 32 (Cap. 590). The goals of this new Board were more expensive and responsibilities than the former ones. For example, it became the advisor to the government on all issues related to the dairy sector. It had the authority to register milk producers, processors, importers, and vendors to license their activities and to set regional milk prices. Moreover, it was authorized to enact by law to govern the smooth running of the sector.

The government created the now-defunct Tanzania Livestock Development Authority (LIDA) in 1974 by an Act of Parliament, and it was tasked with overseeing livestock development. However, the prior Act of the dairy business was not repealed by this Act. Tanzania Dairies Limited (TDL) proved as a subsidiary company of LIDA in 1975. Before LIDA was proven, all milk processing firms that had previously been proven under the firm Ordinance (Cap. 212) were dissolved by government decree, and their assets and liabilities were transferred to the holding company, LIDA (Mwakatundu, 1985).

2.3 Status of Milk production in Tanzania

Figure 4: Top 10 commodities production in Tanzania 2022 (FAOSTAT, 2022)

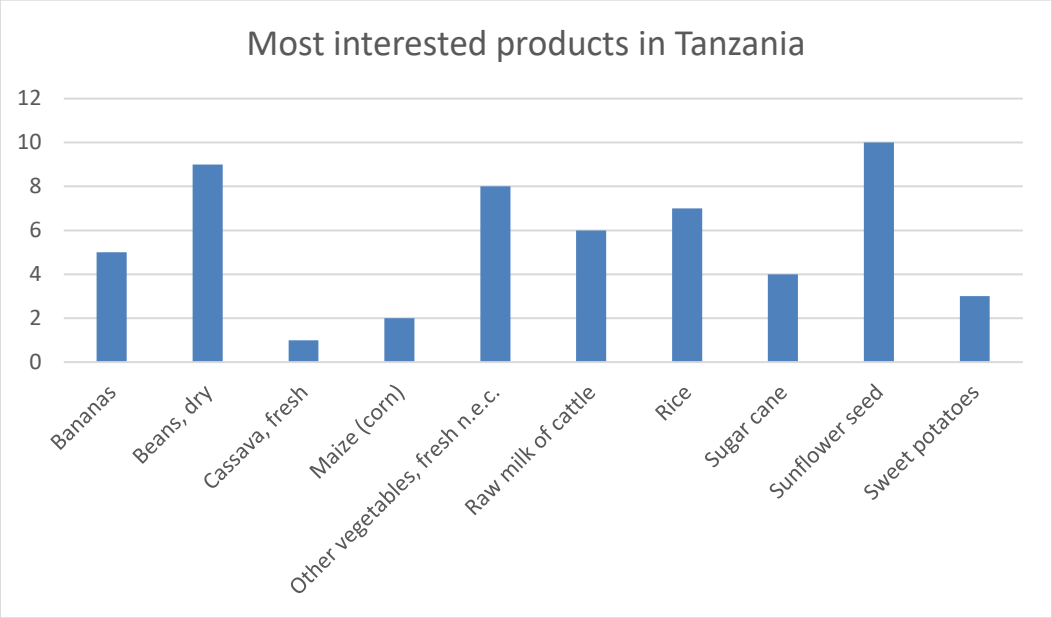


Figure 5: Availability based on supply utilization accounts 2012 - 2021 (FAOSTAT, n.d.-a)

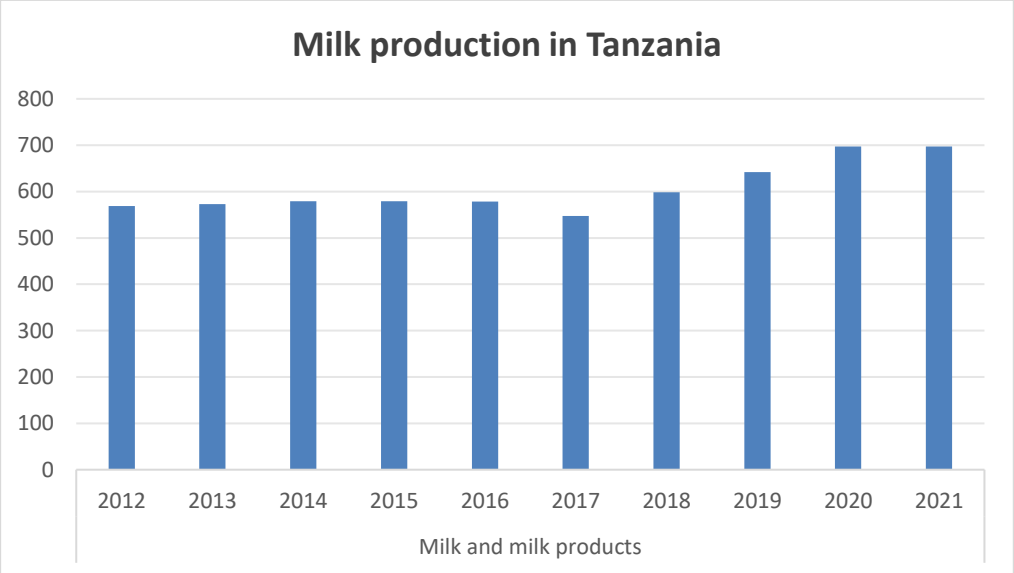
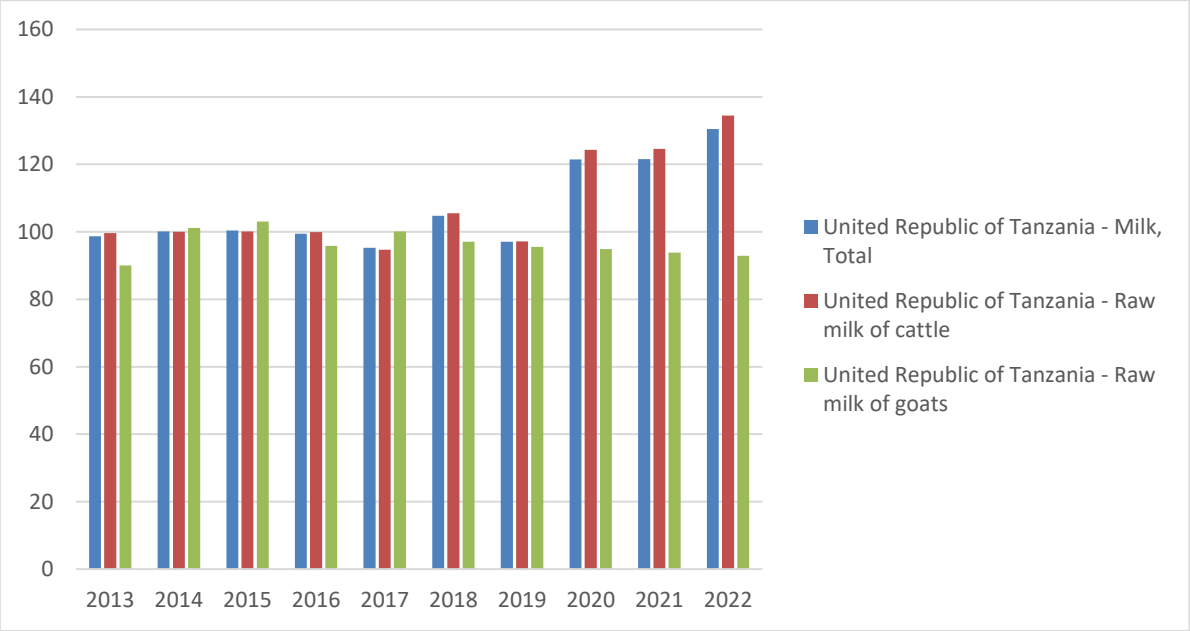


Figure 6: Production indices in Tanzania 2013-2022 (FAOSTAT, n.d.-a)



According to the Tanzania Dairy Board (TDB) and the Ministry of Livestock and Fisheries Development (MOLFD)1 until year 2015 only 3% of the national cattle herd comprised of improved dairy breeds, with disproportionate contribution of 30% of the 2.5 billion litres of annual milk production. They however, account for 70% of the marketed milk. Milk production is mostly for household consumption. Marketed milk sold directly to neighbours (86%) or through small-scale milk traders and collective bulking centres (12%). The country has historically experienced low milk production, which has been attributed to the shortage of improved high-yielding dairy cows, poor pastures/feeds and failure to observe recommended husbandry practices (ESADA, 2015).

The dominance of geographically scattered and poorly organised smallholder dairy farmers has contributed to excessive costs of milk collection/aggregation by milk processors. About 2.4% of marketed milk was in the form of processed products and about half of it is imported. In 2015 there were 83 milk processing plants in the country handling 167,000 litres of milk daily, ranging from many micro-processing units that process very small volumes: to large-scale plants such as Tanga Fresh and ASAS in Iringa. All processors produce pasteurized and cultured milk. For processed milk, the major type is cultured milk widely known in Kiswahili as “mtindi”, consumed as part of a meal as well as refreshment. Pasteurised milk is the second product on the market by volume. UHT is another product that is increasing in popularity. There is a limited segment that prefers consumption of yoghurt, butter, ghee and cheese, whose local production is minor compared to imports. This brief assesses the role of small and medium enterprises (SMEs) in value addition of milk in the country (Lunogelo et al., 2020).

The Livestock Modernisation Initiative (LMI: 2016-2021) aims to increase the proportion of improved dairy herds (mostly Friesian, Ayrshires and Jersey), which in 2015 accounted for only 3% of total dairy herd. According to Tanzania Dairy Board (TDB), milk production had gradually increased from 1.85 billion litres in 2011 to 2.09billion litres of milk per in 2018. The country's per capita consumption of milk is 40 litres per annum, compared to Kenya and Uganda with estimated consumption of 90 litres and 80 litres, respectively. The country is a net importer of milk and milk products, with exports declining to negligible levels in recent years. According to ADB data, the country imported more than 116,650 metric tonnes between 2008 and 2019, worth USD 154,372. In 2016 milk powder constituted 58%, followed by UHT milk at 26%, mostly imported from Kenya, South Africa, Middle East, and the Netherlands. The Government raised import duty on dairy products to protect the domestic industry in 2018 from TZS 150 to TZS 2,000 per kg, which affected the cost of reconstituted milk from milk power (Lunogelo et al., 2020).

In Tanzania 90% of milk produced by cattle. The majority of this produced in low input, low yielding system. The average national milk yield is about 2000 kg per cow per year (CSIRO, 2020).

Table 1; Milk production by livestock zone in Tanzania (Michael, S. et al., 2018)

LIVESTOCK PRODUCTION ZONE	National and production system milk production (thousand litre)						% change
	Base year (2016/17)	2017/18	2018/19	2019/20	2020/21	2021/22	
Central	848,140	884,466	922,348	961,853	1,003,049	1,046,010	23
Coastal and lake	751,923	841,687	942,166	1,054,641	1,180,542	1,321,474	76
Highlands	344,186	401,149	467,541	544,920	635,106	740,219	115
Commercial specialized dairy	214,885	272,832	346,405	439,816	558,423	709,011	230
Total milk production	**2,159,134**	**2,400,134**	**2,678,461**	**3,001,233**	**3,377,121**	**3,816,714**	**77**

Tanzania has experienced a significant increase in milk production, with an estimated 3.6 billion litres produced by 2023.The rise represents an improvement over the 2.2 billion litres reported during the 2020-2021 time frame, since the country milk production capacity stands at 3.6 billion litres and the annual milk country production demand of milk is 12 billion litres

then nine billion litres are required to reach the requirements, according to the report from the ministry of Livestock and Fisheries Abdallah Ulega on 2023/24 Budget in Tanzania Parliament (*Milk Self-Sufficiency*, 2023).

2.3.1 Dairy cows

Dairy farming is one of the most important economic sectors in Tanzania contributing to the livelihoods of more than 2.3 million farmers and livestock keepers in the country. Seasonality highly influences the productivity of dairy cows, worsened by the limited availability of feeds, diseases, and low reproductive rates of the animals. During dry and wet seasons, milk yields in traditional systems are about one litre per cow per day and range from 6 to 12 litres per cow per day in improved systems. Milk contributes to over 50 percent of the farm revenue profile in Tanzania's traditional systems, while meat sales contribute to 48 percent of the total farm revenue. The dairy subsector typically separated into two primary groups: the contemporary sector, which includes grade cattle (crossbreeds and pure breeds), and the traditional sector, which uses local breeds. Milk from grade cattle (crossbreeds and purebreds) raised on medium- to large-scale farms occasionally counted as a third category all its own. Most systems are traditional ones, with local zebu cattle producing milk among their other products in addition to meat, savings, draft, crossbreeding. This technique produces milk primarily for domestic use; only excess is allowed for marketing (Nell, A. J., et al., 2014).
In Tanzania, the common dairy breeds found are Holstein-Friesian, Ayrshire, Jersey, Guernsey, Norwegian red, Sahiwal, Simmentals, and red poll cattle. Tanzania has the second largest dairy herd in East Africa with twenty-eight million cows.

Figure 7: Jersey breed (Home - African Jersey Forum, 2020)

Jersey heifers grazing on maize stubble in Tanzania

Figure 8: Holstein – Friesian breed.

Source: Picture from my photo gallery, I'm on that picture

Figure 9: Ayrshire breed (Project, n.d.)

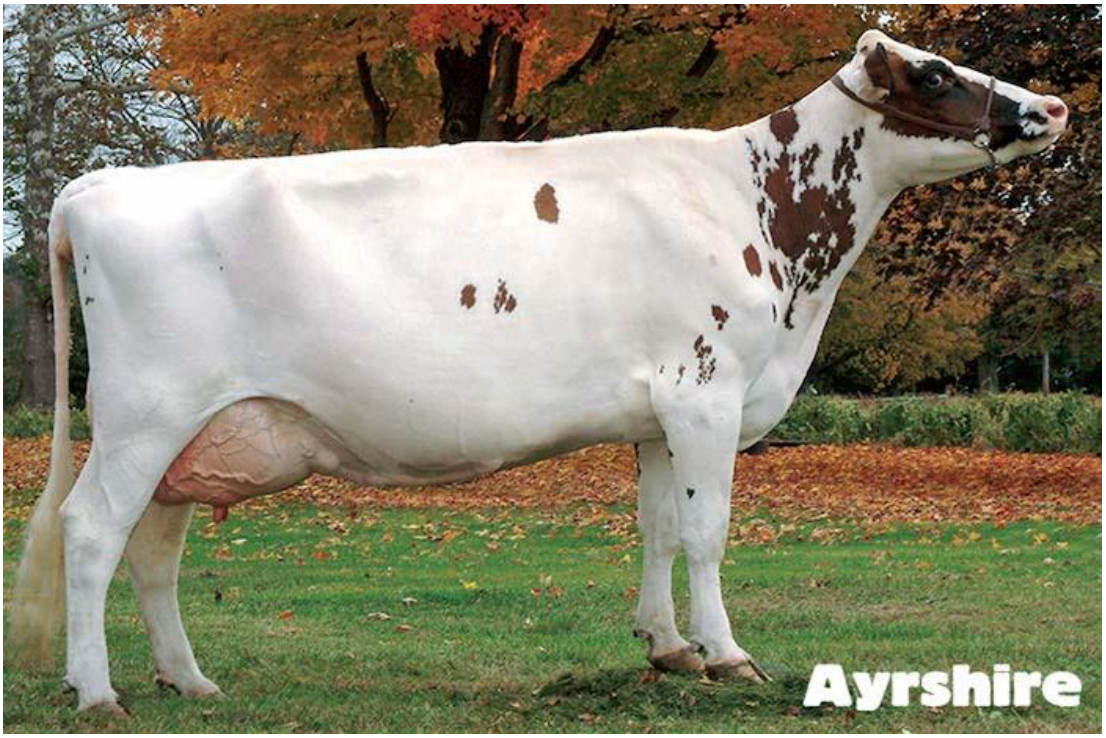


Figure 10: Guernsey breed (Project, n.d.)

Figure 11: Sahiwal breed (Lenstra, 2005)

Figure 12:Norwegiain red breed (Cows Tanzania Zanzibar Stock Photos, Royalty Free Cows Tanzania Zanzibar Images, n.d.)

Figure 13: Brown Swiss breed (Cow-Brown-Swiss (1095×741), n.d.)

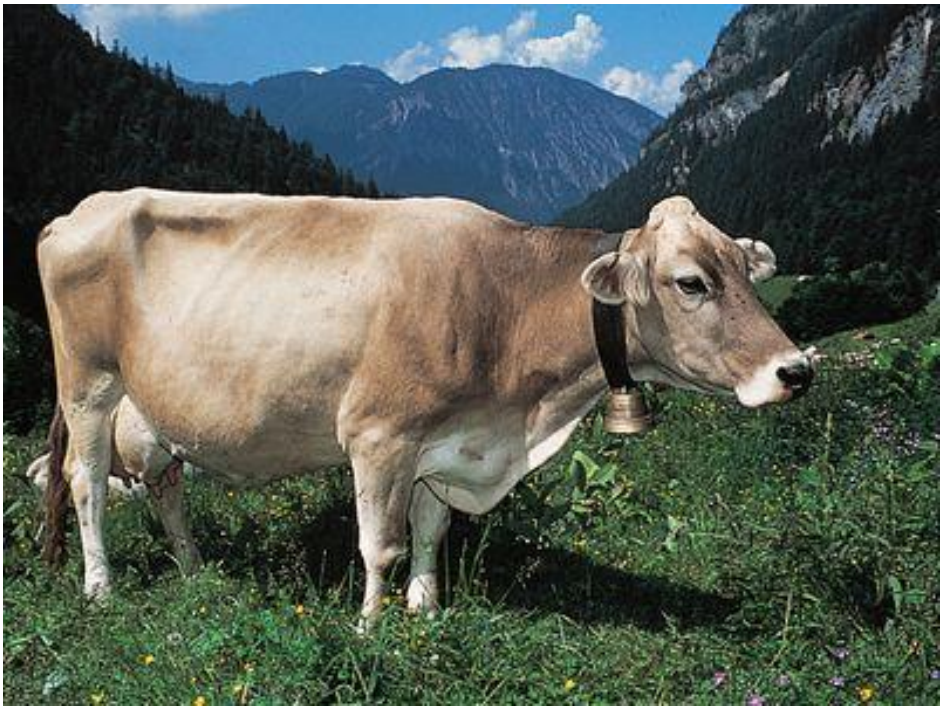


Figure 14: Simmental cattle breed (Simmental - an Overview | ScienceDirect Topics, n.d.)

Figure 15: Red poll breed (The Cow Wall® A-Z Cattle Breed Picture Reference, n.d.)

2.3.2. Dairy goats in Tanzania

Farming families benefit from raising dairy goats since, in addition to the milk's high nutritional value, the meat from these animals is delicious for many homes. You can also utilise goats to supply the farm with manure and to make money. Greater revenue for the farmer with little money starting a dairy goat project allows a farmer to be able to gain from it in a short amount of time moment. Of the 17 million goats worldwide, just 2% are dairy goats in Tanzania. The most common foreign dairy breeds in Tanzania are Toggenburg, Saanen, Norwegian, Aglo Nubian, and French Alpine, which are abundant in Manyara, Morogoro, Arusha, and the Kilimanjaro region.

Figure 16; Toggenburg breed (Sokombi, et al., 2013)

Figure 17; Saanen breed (Saanen Dairy Goat, n.d.)

Figure 18; Norwegian breed (Rønning, 2013)

Figure 19; Anglo-Nubian breed (Nubian Goats Breed Profile - Goat Journal, n.d.)

Figure 20; French alpine breed (712 French Alpine Goat Stock Photos - Free & Royalty-Free Stock Photos from Dreamstime, n.d.)

2.4. Livestock production system and subsystem in Tanzania

Livestock production systems in sub-Saharan Africa can be classified into three categories: landless, mixed rainfed, and grassland-based, according to (FAO, 2002). While the mixed rainfed system is classified into semi-arid, subhumid, humid, and highlands, the grassland-based systems are divided into pastoral and agro-pastoral Livestock farming is a substantial part of Tanzania's agricultural industry and is essential to the survival of numerous rural communities. Tanzania's livestock production system can be broken down into several smaller systems according to the kinds of animals, the methods used in production and the ecological zones. Livestock production systems categories on pastoral system, Agro-pastoral system, smallholder system and Intensive system (commercial system).

The traditional or pastoral system of producing livestock entails herding sheep, goats, and cattle nomadic or semi-nomadic. Pastoralists roam with their herds across wide distances to obtain grazing lands and water supplies, responding to seasonal changes and environmental circumstances. This system is characterised by low input methods, little use of veterinary services, and traditional management techniques. It depends on natural pastures. Pastoral communities primarily prioritise sustenance and maintaining their way of life, with animals acting as a vital source of milk, meat and social standing, There are an estimated 500 million pastoralists worldwide, the majority in developing countries where they face much development and poverty challenges. (McGahey et al., 2014)However, pastoralists are also widespread in most industrialized countries: Australia, China, Europe, the United States of America, and other countries. Pastoralists usually make their living through complex activities, raising livestock not only for domestic use (dairy, fibre, manure, meat, hides) but also for the market to obtain goods they cannot cultivate or manufacture.
Pastoralism in Tanzania is practised by a tribe called Maasai, Maasai Dairy production is recognized as an effective strategy to improve food security among pastoralists and other livestock-dependent groups given that dairy products often provide considerable caloric and nutritional resources. (FAO, 2008) and (Dror & Allen, 2011)). Indeed, in some pastoralist communities, dairy products can comprise over half of the daily caloric intake although this contribution varies across seasons (wet vs dry), ecologies (highland vs lowland), and livestock species kept. Efforts to support dairy production in pastoralist communities are also challenged by the production and consumption of milk contaminated with pathogens (e.g. bacteria, viruses), which can constrain and even reverse the associated beneficial effects. (Iannotti et al., 2013), Pastoralists capitalize on the diversity of rangeland ecosystems by using indigenous livestock breeds that are adapted to both the rangeland environment and the production system. The huge number of pastoralists also keep a variety of livestock species to harness a wider range of resources: for example, combining cattle or sheep for pastures with camels or goats for shrublands. This combination allows pastoralists to use a wider range of ecological niches and also buffers production against uncertainty. (*Improving Governance of Pastoral Lands. Governance of Tenure Technical Guide 6 |Policy Support and Governance| Food and Agriculture Organization of the United Nations*, n.d.).

Agro-pastoral system Tanzania's livestock agro-pastoral system combines crop cultivation with livestock husbandry in a mixed farming strategy. This approach is especially common in the country's semi-arid and desert regions, where pastoral populations make their living from both agriculture and animal husbandry. In addition to growing crops including maize, sorghum, millet, and beans, agro-pastoralists rear cattle, goats, sheep, and chickens.

The agro-pastoral system of the Maasai people is linked to their cultural identity. Their methods are informed by traditional knowledge systems that have been passed down through the years and show a deep comprehension of their surroundings. The Maasai culture places a strong emphasis on conservation principles that support ecosystem health and biodiversity. To avoid overgrazing and preserve ecological balance, for example, their grazing patterns are planned accordingly. Although they are usually located in more marginal locations, agro-pastoral systems in northern Tanzania have historically included mixed crop and livestock agriculture. Even while crop production has typically contributed the most to agro-pastoral livelihoods overall, these farmers have been able to maximise the productivity of the available grassland by keeping large herd numbers with variable degrees of mobility. In the past, communities like the Arusha and Iraqw have engaged in agro-pastoral production in the area; the former have cultivated especially strong social, cultural, and economic linkages with pastoral communities. (*Engaresero Maasai | Globally Important Agricultural Heritage Systems | Food and Agriculture Organization of the United Nations*, n.d.).

Smallholder system

The management of small ruminants, especially goats and sheep, is the focus of Tanzania's smallholder livestock system. These animals, which provide meat, milk, fiber, and skins, are essential to the livelihoods of many households. The size of the herd and the management techniques can be used to classify the production systems into distinct types. Smallholder dairy farming, characterized by small herds of 2– 3 milking cows, provides a livelihood for more than 150 million farm households worldwide.. Most smallholder farmers are found in developing countries. In Tanzania, smallholder dairy farming has rapidly developed in the past 3 decades, due to its successful role in poverty alleviation and bridging the gap to increasing demand for milk and milk products. The job opportunities created by smallholder dairy farming along the dairy value chain—from production to processing and distribution—have a substantial positive impact on rural economies. Increased access to milk and dairy products can result in improved nutrition and higher household incomes (Hemme & Otte, 2010).

Intensive system (commercial system)

Compared to the enhanced family dairy subsystem, the commercial specialised dairy subsystem is more commercialised, and specialised, and has a higher input of feeds and animal health services. Depending on the size of the herd, this subsystem is separated into small and medium-sized farms. Between two and three cows that are primarily crossbred and not mixed with native cattle are kept by farmers on small farms.

With a national average of 450 animals, farmers in the medium commercial and specialised dairy systems tend to own larger herds of cattle, often exceeding 100 cows. These farms have their input delivery systems and are either privately or publicly run. These farms either process

their milk or sell it directly to milk processing facilities (MINISTRY OF AGRICULTURE, LIVESTOCK AND FISHERIES, 2017).

Table 2; GDP Contribution of cow milk production in the commercial specialized dairy subsystem (Michael, S. et al., 2018)

Livestock production	CONTRIBUTION OF COW MILK (TZS MILLIONS)						% Change
Commercial Specialized dairy subsystem	The base year (2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	
	79,678	102,162	130,993	167,959	215,357	276,130	247

Table 3; Change in income per Animal Due to dairy improvement interventions in Commercial Specialized Dairy (Michael, S. et al., 2018)

Production zone/system	Herd size	Income per animal (without added investment)	Income per animal (with added investment)	% Change
	Small herd	311,068	408,949	31
	Medium herd	643,394	834,544	30

2.5. Livestock subsystem in Tanzania

Tanzania's subsystem of livestock is essential to the nation's economy and social structure. It includes a range of conventional and contemporary methods for raising livestock, such as backyard chicken farming, small-scale dairy farming, and pastoral cow herding. For millions of households, each of these systems is essential in generating revenue, ensuring food security, and creating job possibilities.

According to (Nell, A. J., et al., 2014), there are three main subsystems within Tanzania's dairy production system: improved family dairy (IFD), commercial specialised dairy (CSD), and traditional cow meat milk. Since both milk and meat are essential, the conventional cow meat milk production subsystem does not focus on producing just one good. However, in the CSD and IFD subsystems, milk is a priority commodity. The IFD subsystem typically uses little input, contingent on milk market prospects and the presence of milk collection centres.

Cattle are housed in systems of semi- and zero-grazing, fed crop residue, pasture that has been cut from communal land, and farmed fodder.

Conversely, the CSD subsystem is more of a specialised, commercialised dairy system requiring higher input levels use and outputs. Small CSD farms, starting.

at 2–3 cows, keep crossbred cattle. They are like IFD subsystems, except concerning their greater use of inputs, particularly feed and animal health. Medium-sized CSD farms—with more than one hundred cattle and a national average of 450—are either government-owned or private farms with their input delivery systems.
The milk produced in these farms is processed there or goes directly to processing plants. The improvement of the cow dairy system in Tanzania should seek to target the expansion of the IFD (in the coastal lake and highland zones) and CSD subsystems (throughout the country). Many of the challenges, opportunities, interventions, improvement assumptions and investments are shared between the two subsystems.

Table 4; Dairy Production Sub-systems in Tanzania (Michael, S. et al., 2018)

Dairy subsystem	Herd size	Classified under	Average milk production	Average lactation length(days)	Parturition rate
Improved family dairy	1-5	Crop livestock mixed Agriculture	6-8	250-270	0.7
Commercial	5-100 (small) >100 (medium)	Urban and peri-urban specialized dairy	10-12	310	0.75-0.8

2.6. Animal used for milk production in Tanzania.

Tanzania's agricultural industry is varied, and raising livestock is important to the country's economy. Cattle, goats, and sheep are the main livestock used to produce milk among other animals (Table 5, Figure 21.). Every one of these animals makes a distinct contribution to the dairy business by meeting the demands of the market and various consumer preferences. (MINISTRY OF AGRICULTURE, LIVESTOCK AND FISHERIES, 2017).

Table 5; Number of milking animals in Tanzania (FAOSTAT, n.d.-a)

Sum of Value	**Element**	
Item	**Share in total livestock**	**Grand Total**
Cattle	816.78	816.78
Goats	111.25	111.25
Sheep	39.93	39.93
Grand Total	**967.96**	**967.96**

Figure 21; Distribution of the milking animals in Tanzania Year 2012-2021 (FAOSTAT, n.d.-b)

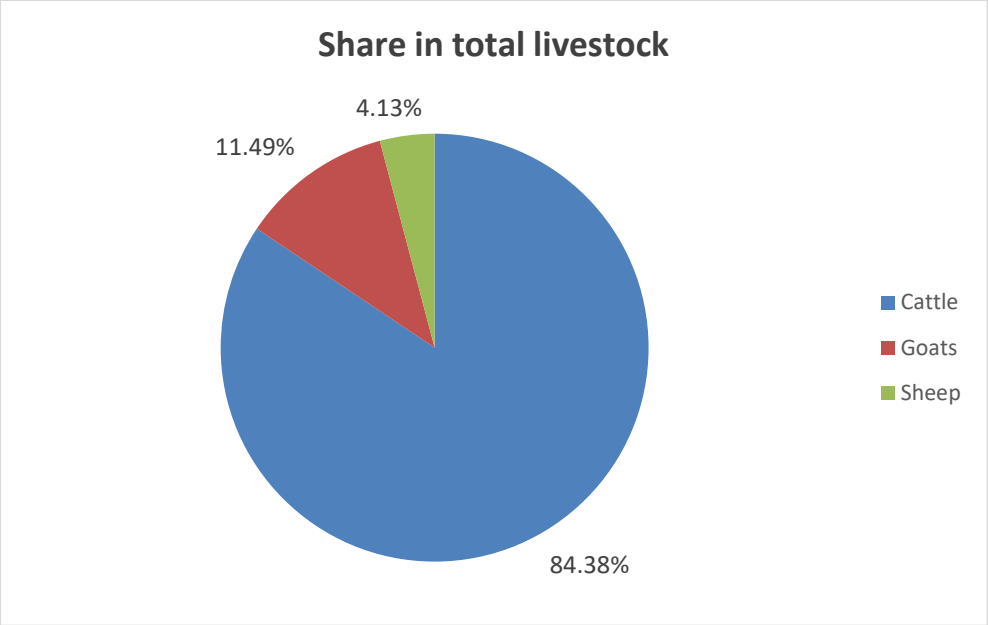


Table 6; Livestock units per agricultural land area (FAOSTAT, n.d.-a)

Sum of Value	Element	
Item	**Livestock units per agricultural land area**	**Grand Total**
Cattle	3.51	3.51
Goats	0.47	0.47
Sheep	0.18	0.18
Grand Total	**4.16**	**4.16**

Figure 22; Livestock units per agricultural land area year 2022 (FAOSTAT, n.d.-b)

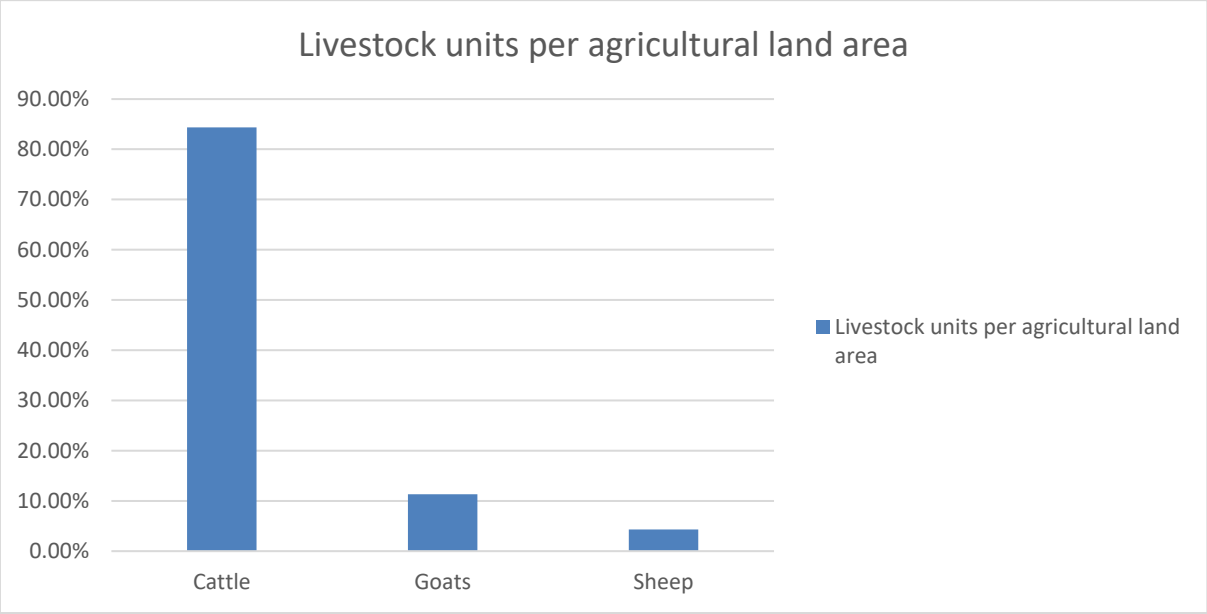


Table 7; Number of ruminants in Tanzania *(*FAOSTAT, *n.d.-b)*

Sum of Value	**Element**	
Item	**Stocks**	**Grand Total**
Cattle	136265184.3	136265184.3
Goats	18579828.42	18579828.42
Sheep	6583792.72	6583792.72
Grand Total	**161428805.4**	**161428805.4**

Figure 23; Change of the stock of ruminants in Tanzania year 2012-2022 (FAOSTAT, n.d.-a)

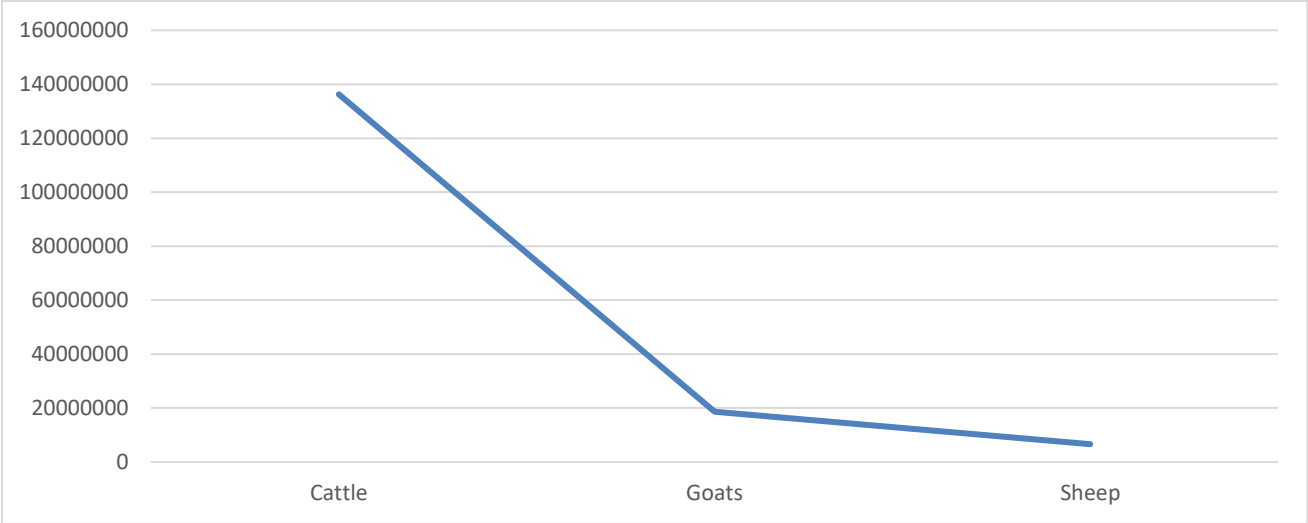
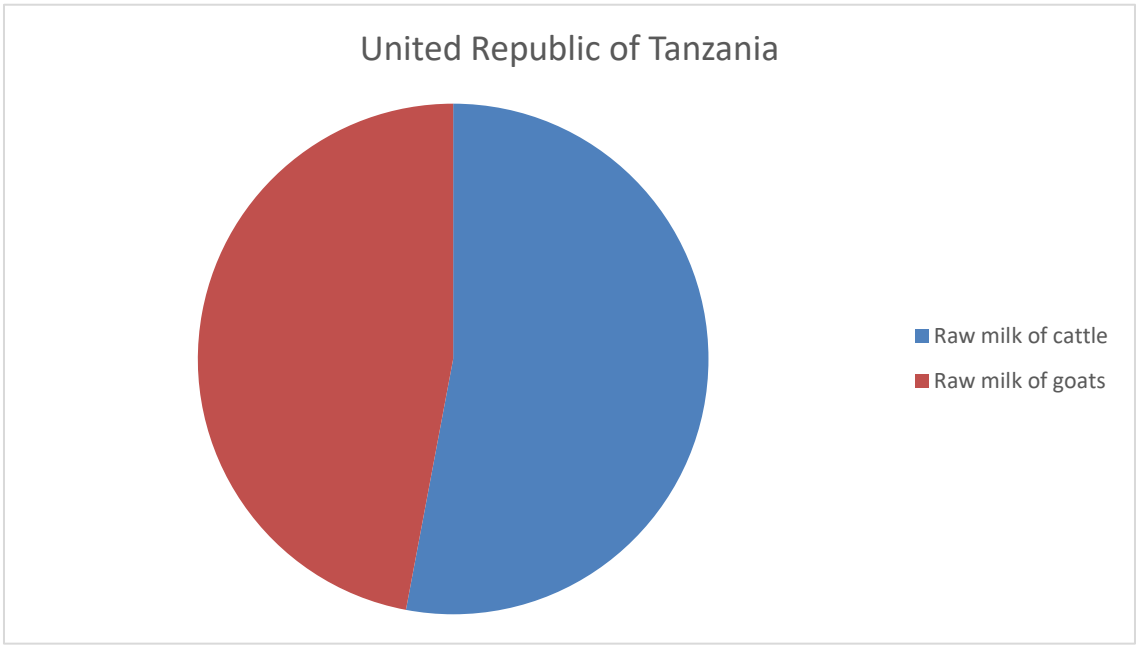


Table 8; Raw milk production of Cattle and Goats 2022 (FAOSTAT, n.d.-b)

Item	United Republic of Tanzania	Grand Total
Raw milk of cattle	52.96%	52.96%
Raw milk of goats	47.04%	47.04%
Grand Total	**100.00%**	**100.00%**

Figure 24; Raw Milk of Cattle and Goats year 2013-2022 (FAOSTAT, n.d.-b)



2.7. Indigenous Cattle in Tanzania

In Tanzania, native cattle are an important component of the agricultural and cultural legacy of the nation. Their primary adaptations are to the various climates, altitudes, and grazing methods found in the area. Native cow breeds are renowned for their ability to withstand adversity, grow on poor-quality feed, and adapt to extreme weather. The native Tanzania Short Horn Zebu (TSZ) population, which includes over 90% of the country's cattle, has been divided into 12 strains according to morphological traits, regional distribution, and historical evidence. However, the lack of precise genetic data for each TSZ population has made it impossible to create initiatives for conservation, breed enhancement, crossbreeding, and selection. (Msalya et al., 2017).

There are two indigenous cattle breeds in Tanzania which are Ufipa and Shorthorn Zebu and the predominant indigenous cattle breed in Tanzania is the Tanzania Shorthorn Zebu, which comes in several strains such as Maasai, Sukuma, Tarime, Iringa Red, Mkalama Dun, Singida White, Mbulu, Gogo, Chagga, Pare, and Zanzibar. These TSZ strains differ in their morphological characteristics, including body size, coat colour, horn size and orientation, and their ability to adapt to various ecological conditions (such as particular climatic, topographical, and feeding conditions). They also typically show variations in their resistance to diseases, parasites, heat stress, and drought. 95% of Tanzania's 25.8 million cattle heads are from the TSZ, which is a large gene pool with a variety of genetic qualities that have not been properly utilised because of insufficient knowledge of their genetic distinctiveness. Animals classified as TSZ typically grow slowly, have low mature weights, low milk yields, and are typically low producers. All native animals are regarded as having two uses and provide 95% of Tanzania's

beef and 70% of its milk. The primary reason for this substantial contribution is not productivity per animal but rather the fact that there are more native cattle than there are improved breeds. Numerous issues, including inadequate nutrition, illnesses, parasites, and low genetic potential, contribute to the low output of TSZ animals.

2.8. Indigenous goat found in Tanzania.

There are 24.8 million goats in Tanzania (NBS, 2020), the majority of which are Small East African (SEA) breeds that are found in nearly all agro-ecological zones. The family's ability to produce meat and milk, generate cash, and perform other sociocultural tasks depends on the animals, which are especially vital to resource-poor farmers in rural locations. Regarded as resilient, SEA goats perform better than upgraded goats in several farmers important attributes, including disease resistance and survival. However, because of the delayed first kidding age of 18–24 months (MAFS 2002), the lengthy 12-month interval between kidding (NEI 1999), the tiny mature size of 24–28 kg (S W Chenyambuga & F P Lekule, 2017) the small carcass weight of 12 kg (MAFS 2002), and the low milk output, the indigenous goats in Tanzania are regarded as low producers compared to their exotic counterparts.

2.9 Cross breed of cattle found in Tanzania.

Genetic Composition and Breed Types

- RED-GUE**:** Norwegian Red/Friesian-Guernsey or Norwegian Red/Friesian-Jersey
- RED-HOL: Norwegian Red/Friesian-Holstein
- RED-Zebu: Norwegian Red/Friesian-zebu
- Zebu-Red: Zebu with Norwegian Red/Friesian ancestry (Mujibi et al., 2019)

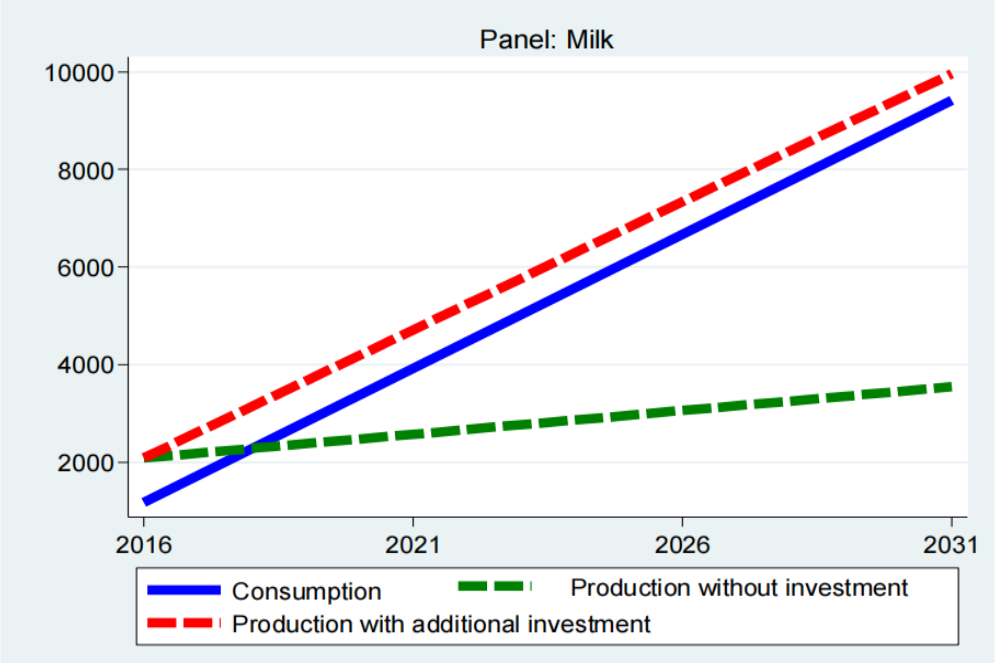
2.10 Goat cross breed in Tanzania

A famous goat crossbreed in Tanzania, especially in the Dodoma area, is called the Blended goat. The goal of the breeding program that produced this breed was to combine distinct genetic features from other breeds to increase goat productivity. Boer, Kamorai, and native East African goats are the three breeds that make up the blended goat. About 55% of the makeup is usually made up of native goats from East Africa, 30% Buha from South Africa, and 15% Kamorai from Pakistan (Das & Sendalo.M, 1991)In regions of Dodoma like Mpwapwa, where farmers are increasingly embracing this crossbreed to better their livelihoods through improved income production and nutritional benefits, the breeding program for these blended goats is still in progress. To ensure that the blended goats can flourish in the local environment and provide higher yields, the initiative's success depends on community involvement and appropriate management techniques.

2.11. View of Tanzania livestock ministering

The Tanzanian government has acknowledged the importance of the dairy sector as a critical part of the agricultural economy, contributing to food security, nutrition, and income generation for rural people. Through several projects designed to boost milk output and enhance the living conditions of dairy farmers, the Ministry of Livestock and Fisheries has been actively involved in promoting the dairy industry.

Figure 25; Production-consumption balance for cow milk with and without additional investments for Tanzania, 2016–2031(Stephen et al., 2018)



2.12. Challenges of milk production in Tanzania

In Tanzania, milk production is season sensitive, fluctuations of feeds in both quantity and quality being the major driver, due to erratic supply of feed quality and quantity, limited access to land for grazing, production of forages and forage seed due to an unclear land tenure system and limited availability and high cost of forages feed and limited supplementation during a dry season decline in milk production of over 40% due to feed scarcity is a common phenomenon for example, the average milk production of a crossbred cow (Friesian × Boran) under smallholder conditions in Tanga region was estimated to be 4 and 8 L of milk in the dry and wet seasons, respectively (Cadilhon et al., 2016), while the recommended milk production potential for such animals in East Africa is 15-20 L per cow per day (Lukuyu et al., 2015). Inadequate supply of good-quality animal feeds is among the major hindrances for constant year-round high milk production in Tanzania and East Africa at large (Swai & Karimuribo, 2011).
Animal health services by inadequate supply of drugs, unprofessional people treating animals without certification by authority, hence influencing high calf mortality, poor quality control of drugs and supplies, Mastitis disease is among the most challenging in milk production, Trypanosomiasis and insufficient awareness of cattle disease from farmers.

Marketing and processing due to the unreliable transport system, existing informal trade of raw milk which poses a threat to spreading zoonoses, limited promotion of dairy-product consumption, an absence of quality control and enforcement mechanisms, an absence of quality-based pricing incentives, poor milk quality marketing and low price of milk, a narrow product range which is concentrated on short shelf-life products such as liquid and fermented milk and fluctuations in milk supply due to seasonality (dry and wet season).
Policy unfavourable policies such as pricing have disincentive effects on milk processing and over-regulation of the dairy industry resulting in multiple taxes which is a burden to investors.
Low genetic potential of Indigenous animals for milk production due to inadequate and inefficient artificial insemination (Stephen et al., 2018).

3. METHODS OF THE STUDY

3.1 Data collection

For this study, descriptive statistics data were acquired via secondary data. Data were collected from existing reports and databases, including FAOSTAT, Tanzania dairy reports, Ministry of Livestock and Fisheries Development statistics, and global milk production data from sources such as Our World in Data, except only in the chapter on improving dairy production in Tanzania in a subsection on using artificial insemination. I collect data from the field at Rungwe District in Tanzania through a District Artificial Insemination Technician, Mr. Henry Mwambalulu.

3.2 Methodology

The research evaluated current data on milk production, cow numbers, and socioeconomic aspects affecting dairy farming in Tanzania, augmented with stakeholders in the dairy sector and including regression analysis, and was used to identify relationships between cattle population, breed types, management practices, and milk production levels.

The study will evaluate low-cost strategies to enhance milk production through breeding programs that analyse the impact of artificial insemination (AI) and crossbreeding on milk yield and feed management by assessing the effectiveness of improved feeding practices, including hydroponic fodder systems and pasture management, and health and hygiene practices that evaluate current milking and storage practices to identify areas for improvement in hygiene and animal health.

4. RESULTS AND DISCUSSION

4.1 Improving Dairy Production in Tanzania

Table 9; Current and projected number of crossbred cattle by production zone in Tanzania (Michael, S. et al., 2018)

	Livestock production zone	Number of crossbred cattle in improved family dairy and commercial specialized dairy						% change
		Base year (2016/17)	2017/18	2018/19	2019/20	2020/21	2021/22	
Improved family dairy	Coastal and lake	156,857	339,596	568,881	842,297	1,162,868	1,394,338	789
	Highlands	375,337	460,801	556,671	665,979	790,043	930,286	148
	Total in improved family dairy	532,194	800,397	1,125,552	1,508,276	1,952,911	2,324,624	337
Commercial specialized dairy	Commercial specialized	250,800	304,348	369,330	448,185	543,877	660,000	163
National number of crossbreeds		782,995	1,104,745	1,494,882	1,956,462	2,496,788	2,984,624	281

Table 10; Current and projected milk production in Tanzania (Michael, S. et al., 2018)

Livestock production zone	National and production system milk production (thousand litre)						% change
	Base year (2016/17)	2017/18	2018/19	2019/20	2020/21	2021/22	
Central	848,140	884,466	922,348	961,853	1,003,049	1,046,010	23
Coastal and lake	751,923	841,687	942,166	1,054,641	1,180,542	1,321,474	76
Highlands	344,186	401,149	467,541	544,920	635,106	740,219	115
Commercial specialized dairy	214,885	272,832	346,405	439,819	558,423	709,011	230
Total milk production	2,159,134	2,400,134	2,678,461	3,001,233	3,377,121	3,816,714	77

Table 11; Annualized milk productivity of cows in traditional and improved family dairy and commercial specialized dairy (Michael, S. et al., 2018)

Livestock production zone	Milk production per reproductive female per year (litre)						% change
	Base year (2016/17)	2017/18	2018/19	2019/20	2020/21	2021/22	
Traditional and improved family dairy	165	174	184	194	205	216	31
Commercial specialized dairy	1,757	1,839	1,925	2,015	2,108	2,207	26
National	179	192	206	221	237	254	42

4.2 Breeding Improvement Strategy

Modernization of the dairy industry in Tanzania has involved the introduction of exotic breeds of cattle from Europe and elsewhere in efforts to improve the genetic potential for milk yield by local zebu cattle through crossbreeding. (Shem et al., 2002). This has been achieved using bull centres. A bull and several dairy cattle were given to the farmers in the chosen model communities so that the bull and the Indigenous stock could mate, Use of Artificial insemination, Livestock multiplication Units and multiplication within smallholder farms(*Dairy Germplasm Development and Delivery in Africa*, 2014).

Selection within local breeds: Establishing structured breeding programs that focus on selecting individuals with desirable traits, selection work on the indigenous cattle by the British colonialists proved that the potential for milk production was limited. Characterization of the indigenous cattle was done in 1926. The Ankole, Masaai, Chaga, Iringa red, Mbulu, Singida white and Mkalama dun strains/breeds were identified and later characterization identified other distinct strains like the Fipa, Gogo, Pare, Singida white, Tarime and strains(*Dairy Germplasm Development and Delivery in Africa*, 2014).

Development of the Mpwapwa Breed: Mpwapwa cattle are a synthetic dual-purpose breed developed in the Livestock Production Research Institute at Mpwapwa in Tanzania. The breed has received about 60% of its inheritance from improved dairy breeds originating in the Indian subcontinent (Red Sindhi and Sahiwal), about 30% from African zebu breeds (Boran and Tanzania Shorthorn zebu) and the remaining 10% from European breeds (mainly Ayrshire)(Syrstad, 1990).

Direct importation of dairy breeds of Bos taurus: Tanzania has brought in live bulls and heifers from throughout the globe. Heifers and bulls from the United States, New Zealand, Kenya, and Zimbabwe were air freighted in massive quantities, heifers were imported into the nation from New Zealand and the USA between 1975 and 1993. These importations had been made possible in large part by funds from HPI and a loan from the World Bank(*Dairy Germplasm Development and Delivery in Africa*, 2014) Among the places where cattle are allocated is Kitulo farm at Southern Highland in Tanzania and the goal was to stock huge scale farms where they could multiply and thereafter surplus heifers be distributed to smallholder farmers.

4.3 Using Artificial Insemination.

Even though it's on a small scale and in a difficult AI delivery context. Intending to expand the use of AI services throughout the nation, the government established NAIC in Arusha in 1982 to encourage the use of these services. MLFD now helps NAIC by producing semen and providing inseminator training. With a total of 172,000 doses of semen and 39,150 litres of liquid nitrogen generated in 2011–12, NAIC's output level has increased over time. Through the establishment of zonal AI centres, the MLFD seeks to enhance and advance AI field services. There are now four zonal AI centres: the eastern zone (Dar es Salaam), the southern highlands zone (Mbeya), the lake zone (Mwanza), and the central zone (Dodoma). According to (MLFD, 2012), all four have LN2 plants and tanks. The main goals are to lower operating costs, draw in additional farmers, and bring the services closer to the users. AI is frequently available and used

on commercial farms, particularly in intensive dairy production, to varying degrees. However, the use of AI services to create crossbreds inside traditional herds has not been very prevalent. From September 2023 up to March 2024, the Tanzanian government offered free cows' artificial insemination in twenty-six regions, including the Mbeya region, and within those regions, their districts selected, including the Rungwe district in the Mbeya region, as shown in Figure 26. The artificial insemination technician did service to a cow, and Figure number twenty-seven shows the results of artificial insemination with a beneficiary woman holding two calves, from which I got the data on services from the district artificial insemination technician. The total number of cows that were inseminated was 3836, and the types of breeds of cows that were inseminated are Friesian, Jersey, Ayrshire, Norwegian Red, and Zebu. Up to 15/10/2024, the calves recorded resulted from that service being 462, and the semen used are Majesty 235, Ice 028 Ayrshire, Ajax 302, Moon 415 Jersey, must 030 Ayrshire, Doit 274 Friesian, and Push 232 Friesian.

Figure 26; Artificial insemination Technician inseminate a cow, location Rungwe district (Tanzania)

Figure 27; Calves result from Artificial insemination service, Location: Rungwe District (Tanzania)

4.4. Improving of feeding?

The Eastern Zone of Tanzania's feed resources are evaluated mostly through laboratory investigations, and the literature does not provide enough information about the resources' quality (FAO 1981). Not much research has been done to link the performance of farm animals with the assessed quality of naturally occurring foods. An on-farm assessment of the available feed resources, considering animal performance, may reveal the primary limitation of a given livestock feeding program. From the evaluations, potential adjustments to raise animal productivity and, in turn, household living standards may be inferred.

Adoption of improved feed production in Tanzania is still poor despite being promoted for decades, improving feed quality is crucial for enhancing dairy production in Tanzania. The current feeding systems primarily rely on native grasses and crop residues, which are often insufficient in nutritional value. By transitioning to more nutritious feed options, such as high-quality forage and concentrate feeds, farmers can significantly increase milk yields; to meet its targets, the Tanzania livestock master plan (LMP) gives feed availability and quality a high priority. There are currently not enough animal feed resources in the country, even in a pleasant weather year of forage production, The Government insist on farm optimization of production and use of high-yielding pasture varieties including Napier grass (Pennisetum purpureum.) and leguminous fodder species. Since the early 1980s, Tanzania has made efforts to support the right mixing of concentrates, such as cotton seedcake, sunflower seedcake, maize bran, leaf meals, and mineral-vitamin premixes, to supplement the inadequate roughages. The goal of this technique is to guarantee that dairy calves receive the nutrition they need for both optimal production and upkeep throughout the year. These technology packages were a part of earlier dairy development programs like Heifer in Trust, which supported smallholder dairy production with zero-grazing systems (Swai & Karimuribo, 2011). Among the techniques and technology that were encouraged were the creation and appropriate application of homemade dairy cattle rations. Most smallholder farmers still do not supplement dairy cattle; however, the technique

is still restricted to a small number of commercial dairy farms. However, supplements frequently provide a tiny quantity of imbalanced concentrates to cows to calm them down during milking or increase milk production (Lukuyu et al., 2015). Furthermore, in contrast to commercial farming, which is specialised, small household dairy farms frequently run several businesses (mixed farming) that are driven by risk diversification (FAO, 2010). Since dairy farming is a secondary business to crop production, Small Dairy Farms might become unfocused and occasionally concentrate only on using manure as an advantage for crops and animals.

Figure 28; Harvesting of Pennisetum purpureum in Tanzania (Kimani, 2020)

4.5 Improving of hygienic?

Basic or primitive safety and hygiene procedures were followed. Many preventive measures for feed storage control, hygiene, and animal health were absent. Throughout the dairy chain, milk cooling is not a standard practice. There is also a risk to milk safety because there is little monitoring of milk safety and quality measures, especially for pathogenic bacteria. Compared to the commercial program, farmers felt that the non-commercial program offered greater assistance for their on-farm safety and hygiene management activities. Traditional milking techniques are used by many farmers, although there are common problems such as improper equipment cleaning and the use of non-sterile storage and transportation containers. Considerable improvement is needed in several safety and hygiene control procedures to mitigate the dangers to public health posed by rising milk consumption. Mastitis in both clinical and subclinical forms is the main disease that affects milk production. In addition to decreasing productivity, mastitis lowers milk quality due to compositional changes in the milk as well as drug contamination from the disease's treatment. Other variables that can affect milk quality include adulteration, deterioration due to improper storage, and contamination during dishonest middlemen or animal attendants. Furthermore, milk readily absorbs odours after milking. Adulteration also occurs most frequently when water is added to the surroundings due to its high-fat content. On smallholder dairy farms, optimal productivity is further constrained by limitations in milk marketing. The income generated from milk production is further reduced when milk is not processed into higher-paying goods. Considering the high frequency of elements that lead to subpar milk quality (Mdegela et al., 2009) Due to poor milk hygiene more milk is disposable before reach into the market.

Figure 29; A health officer in Mwanza supervising disposal of adulterated milk by a milk vendor (Kurwijila & .Boki, 2003)

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusion

The dairy industry has shown significant potential for growth, driven by increasing demand for milk and expansion of small-scale milk producers, However, the marketing functions of the dairy sector are lagging, leading to inefficiencies that hinder optimal production and distribution. The socio-economic changes, including market liberalization and urbanization, have created both challenges and opportunities for milk producers. Despite the increase in milk prices over the years, smallholder farmers face competition from urban and peri-urban producers who can offer higher quality milk due to better resources and practices.

The analysis indicates that while there is a steady rise in milk demand, particularly for fresh milk, smallholder farmers must improve their production methods and marketing strategies to remain competitive. The current structure of the dairy market Favors larger producers who can meet institutional demands more effectively than smaller farms.

5.2. Recommendations

To boost prompt milk production in Tanzania and be the hub for milk production internationally must do research and domesticate buffalo as the domestic **water buffalo** (*Bubalus bubalis*) contributes a significant share of global milk production and is the major milk-producing animal in several countries such as in India which According to production data of Food and Agriculture Organization Corporate Statistical Database (*FAOSTAT*, n.d.-b)India is the highest milk producer i.e., ranks first position in the world contributing twenty-four per cent of global milk production in the year 2021-22 The dairy industry in India is unique among large-scale milk-producing countries in terms of its large share of buffalo milk. Until 2013, buffaloes accounted for more than half of all milk produced in the country, Tanzania has more chance to take over as the most cape buffaloes and according to the International Union For Conservation of Nature Tanzania has the highest number of buffaloes in Africa and there are four subspecies, the forest buffalo, West Africa savanna buffalo, Central Africa buffalo, and southern savanna buffalo.

Strengthening Smallholder Dairy Output: Smallholder dairy farmers provide a substantial contribution to the nation's milk supply, and their support is essential to increasing milk output. This can be accomplished by implementing focused training initiatives that enhance animal husbandry techniques, nutrition, and health care. Access to high-quality feed and veterinary care will also contribute to higher milk output.

Formation of the cooperative: contributes significantly to raising milk production's quality and quantity. By combining their resources, farmers can obtain improved veterinary care, nutrition, and training—all critical for raising milk production and maintaining health standards. Farmers can bargain for better milk prices thanks to cooperatives' facilitation of collective bargaining power. Shared infrastructure, such as processing plants, can also result in better product quality

and easier access to markets. In general, cooperatives encourage cooperation, which results in sustainable farming methods and higher profits for dairy farmers who operate small farms and will ensure that fresh milk reaches urban consumers promptly, reducing spoilage and increasing profitability for producers.

Promoting Consumer Awareness: the nutritional benefits of milk consumption are crucial for enhancing the demand for locally produced dairy products. Milk is a rich source of essential nutrients, including calcium, protein, vitamins A and D, and various B vitamins. These nutrients play a vital role in maintaining overall health, supporting bone development, and improving immune function. However, many consumers may not fully understand these benefits or how they contribute to a balanced diet. To effectively increase awareness, targeted campaigns can be developed that focus on educating urban populations about the importance of incorporating dairy into their daily meals. Such campaigns could utilize various media platforms—such as television, radio, social media, and community events to reach a wider audience. Informative materials like brochures and posters can be distributed in schools, markets, and healthcare facilities to further disseminate knowledge about the advantages of milk consumption and collaboration with local influencers and health professionals can enhance the credibility of these campaigns. By leveraging their expertise and reach within communities, these figures can help convey messages about the nutritional value of milk more effectively. Workshops or seminars could also be organized to provide hands-on education about dairy products' preparation and usage in traditional Tanzanian dishes, Showcasing the achievements of regional dairy farmers who have profited from rising demand can encourage customers to support regional manufacturing. In addition to encouraging better eating habits, this strategy fosters economic development in rural areas by building a steady market for milk products made from local milk sources.

Market information system: since it gives companies vital knowledge about consumer preferences and price patterns. By acting as a conduit between farmers and the market, these technologies let farmers monitor and assess pricing trends over time and make well-informed choices based on up-to-date information. Farmers can find trends that show when to sell their goods for the biggest profit by gathering data on commodity prices from many places. Farmers can adjust their planting plans; for example, if past data suggests that seasonal demand causes prices for a specific crop to climb during specific months, this proactive strategy improves overall profitability by reducing the risks brought on by price changes. Farmers can customise their production tactics by knowing what customers want, such as particular crop varieties, organic goods, or products gotten responsibly. Farmers may enhance their sales and minimize waste from unsold products by matching them with market needs. For instance, farmers in Tanzania's metropolitan regions can modify their methods to cater to the rising demand for organic farming.

Support from government policies: The government can implement subsidies to improve dairy farming by targeting high-yielding breeds, which can produce more milk than traditional varieties. This can increase milk production and improve herd health. Financial aid programs can also help farmers access modern equipment, such as milking machines and feed mixers, which can be expensive. Low-interest loans or grants can help farmers access this technology,

improving efficiency and milk quality. A supportive policy framework should be established to encourage investment in the dairy sector while protecting smallholder interests from market fluctuations and competition. This could include price stabilization mechanisms or insurance schemes tailored for dairy producers.

Technological interventions: Pasture quality is crucial for livestock production, especially in regions with dry seasons leading to milk production drops. Technological interventions can enhance the carrying capacity of pastures, ensuring they support livestock effectively throughout the year. Key strategies include over-sowing with high-quality forage seeds, reducing bush encroachment, establishing private pasture and seed farms, and hydroponic fodder technology. Over-sowing with legumes, which fix atmospheric nitrogen, enriches the soil and improves pasture health. Bush encroachment, a common issue in grazing lands, can be managed through controlled grazing, mechanical removal, or targeted herbicide application. Private pasture and seed farms can provide high-quality seeds tailored for local conditions and facilitate research and development efforts. Hydroponic fodder technology offers a solution for producing green feed supplements during dry seasons, using nutrient-rich water instead of soil. This method provides high nutritional value while requiring less space and water than conventional farming methods, ensuring a consistent supply of nutritious feed even during drought or pasture scarcity.

Quality milk testing is a critical component of dairy farming, particularly for small-scale farmers in Tanzania. The ability to assess the quality of milk not only ensures consumer safety but also enhances the marketability and profitability of dairy products. Farmers should be educated in the basics about testing milk by the organoleptic test but also microbial testing load to know the number of bacteria present in milk and the number of somatic cells count for signifies mastitis, and let them know the essence of practising high hygiene, which leads to increased profitability and safety of milk for consumers and by producing

6. SUMMARY

The study focuses on increasing milk production in Tanzania in terms of quality and quantity, hence improving the living standard of livestock keepers by boosting their income and contributing to the gross domestic product of the country by exporting quality milk accepted by the International Organization for Standardization and other boards specializing in milk production quality. The study targets to produce more milk in Tanzania and reach an estimated plan in 2031, which indicates Tanzania will produce 3,384,970 metric tonnes of milk (source: the book Tanzania livestock sector analysis 2016/2017-2031/2032, page 53, table number 19, title Baseline projected livestock production in Tanzania 2016–2031) with the Annual growth rate (%)1 of 3.44 between the year of 2016-2031. Tanzania is estimated to produce 3,331,067 metric tonnes of milk in 2021(source: Our World in Data_milk production 2021). Data show that Tanzania is ranked as the thirteenth top country on the population of cattle in the world (source: Our World in Data cattle population by country 2021), and at the same time, data collection showed Tanzania is ranked thirty-nine (39) in milk production in the world (source: Our World in Data milk production 2021). With this huge difference between the number of cattle present and the ranking of milk production in the world, I analysed how the number of cattle could relate to milk production and Tanzania being recognized as a huge contributor to milk production in the world; nevertheless, seasonality, disease, and inadequate management contribute to the low productivity levels of dairy animals. The goal of the study is to assess low-cost ways Tanzania might increase milk production, quality, and quantity from dairy cattle while also promoting economic growth for the nation, milk processors, and livestock caretakers. Global milk output climbed from 534 million tonnes in 1992 to 930 million tonnes in 2022, a 77% increase over the previous three decades. Only 3% of the country's cattle herd is made up of improved dairy breeds, despite this accounting for 30% of the nation's yearly milk production, according to reports from the Tanzania Dairy Board and the Ministry of Livestock and Fisheries Development. Still, they make up 70% of milk that is sold. Low milk output has historically been a result of inadequate pastures, a lack of high-yielding dairy cows, and a disregard for advised husbandry procedures. For more than 2.3 million farmers and livestock keepers in Tanzania, dairy farming is essential because milk accounts for more than 50% of agricultural income. Using local breeds, the dairy subsector is split into modern and traditional sectors. Friesian, Ayrshire, Jersey, Guernsey, Norwegian red, Sahiwal, Simmentals, and red poll cattle are among the common breeds of dairy cattle used in Tanzania. Native cattle from Tanzania, particularly the population of Tanzania Short Horn Zebu, are essential to the nation's agricultural and cultural legacy. These resilient breeds are renowned for their ability to adapt to many climates, elevations, and grazing practices. Tanzania’s livestock systems consist of three main systems: free-range, semi-intensive, and zero grazing. The free range allows animals to find the feed on their own, while semi-intensive allows animals to graze under supervision and receive supplement feed. Zero grazing involves cutting and carrying pasture for indoor cattle, providing all maintenance and production requirements. Tanzanian milk production is seasonally dependent, primarily because of variations in feed amount and quality. Tanzania's dairy sector is being enhanced using various breeding techniques. To promote AI services in the nation, the National Artificial Intelligence Centre was founded, with the initial focus being

on crossbreeding traditional zebu cattle with Bos taurus cattle. The Tanzania Master Plan prioritises feed quality and availability to increase a nation's milk output. The dairy chain does not follow standards for milk cooling and does not take preventive measures for animal health, hygiene, or feed storage. Traditional milking methods are still in use, but to reduce the hazards to the public's health, changes must be made. Problems with non-sterile containers and inadequate equipment cleaning continue. The dairy business is expanding because of small-scale producers and growing consumer demand. However, optimal manufacturing and distribution are hampered by inefficiencies in marking. To be competitive, smallholder farmers need to modernise their marketing plans and production techniques. The existing structure of the dairy market favours larger producers that can better meet institutional demands than smaller farmers. Tanzania must prioritise increasing milk production and developing into a global centre for milk production. Domesticating buffaloes is essential to the world's milk production, especially in Tanzania. Milk production can be made more both qualitatively and quantitatively by founding cooperatives, bolstering smallholder dairy output, and raising consumer knowledge of the milk's nutritional advantages. Government regulations, technical advancements, and market information systems can all enhance dairy farming. Important tactics include creating private pasture and seed farms, decreasing bush encroachment, over sowing with premium seeds, and using hydroponic fodder technology. These methods use less water and space and offer excellent nutritional value.

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Finally, I dedicate this thesis to my Father Clement Mokiwa, who instilled in me from a young age the value of education, his unwavering belief in my abilities inspired me to set high goals and work diligently towards achieving them, May God continue to rest him in peace.

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