Milk Society and Industrialisation in East Africa

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Abstract

This paper explored the relationship of milk society and industrialisation in East Africa by analysing milk production and inclusive mechanisation. Study countries are Kenya, Tanzania, Uganda, Burundi, Rwanda and South Sudan as East African Community (EAC) member states. The application of documentary research and literature analysis methods revealed that the milk societies are heading towards industrialisation through mechanisation of milk production. However, opportunities still exist in non-mechanised or traditional milk production via milking cows by hand. This study recommends that additional revenue sources for milk societies through cultural tourism by welcoming visitors to experience non-mechanised milk production as seen in Igongo Cultural Centre Museum should be promoted in order to have sustainable industrialisation but consider the culture attachments and views to cows for each country. The implication of this study is for stakeholders to emphasise mechanized milk production by small-scale producers relating to pasture so as to promote inclusive industrialisation.

Keywords: milk society, industrialisation, East Africa

Introduction

Milk society in the context of Bangladesh refers to milk producing societies (Azad, Hasanuzzaman, Miah, & Roy, 2002). In 2015, the European Centre for Development Policy Management (ECDPM) showed that milk production from cows is predominant in Eastern Africa. Eastern Africa is the leading milk producing region in Africa representing 68% of the continent's milk output (ECDPM, 2015). For example, Rwanda's average milk production from 2000 to 2013 was 188 million litres (Nyamwaro, Mugabo, Kalibwani, Tenywa, Buruchara, & Fatunbi, 2018). The report by Cornucopia Institute (2018) further noted that the shift towards factory farms for purposes of yielding highest volume of milk per cow and per acre of land using heavy grains and concentrated protein diet by confining cows in large buildings or feedlots is referred to as industrialisation.

Industrialisation plays a major role in a nation's economic development (Martorano, Sanfilippo, & Haraguchi, 2017). Industrialisation is enhanced through promoting sustainable industrial development in the East African countries of Kenya, Tanzania, Uganda, Rwanda, Burundi and South Sudan as East African Community (EAC) member states (Gache, 2012; EAC, 2012).

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Whereas the aim is to move towards industrialisation, recent scholars have cited the problem of low milk production in dry seasons which is facilitated by lack of promotion on adoption of improved feed production (Maleko, Msalya, Mwilawa, Pasape, & Mtei, 2018). In addition, Maleko et al. argued that the major driver in milk production by smallholder farming systems is fluctuations of feeds in terms of quantity and quality which can be improved through the adoption of nutrition technologies mainly high yield pasture varieties like napier grass and leguminous fodder species.

Although milk production has received much attention in literature (Mathur, 2000; Ugwu, 2010; Sudhir & Kalule, 2014; Maleko et al., 2018), there are limited studies that use the term milk society in reference to milk production by societies that own cows for milk production. Studies on inclusive industrialisation through mechanisation within East Africa are scant and those that have addressed mechanisation are in countries such as Egypt. For instance, Samer (2009) monitored advances in mechanisation of milk production in Egypt through milking machine design. Similarly, studies that use the dichotomy theory are concentrated in tourism where travel choices are concerned but rarely in analysing mechanisation dichotomy in milk production (Qi, 2016; Canosa, Moyle, Moyle, & Weiler, 2017).

East African countries have milk production levels ranging from one to five litres per cow per day (Global Agriculture and Food Security Program, 2016). For instance, Kenya produces five litres per cow per day whilst Tanzania produces nearly two litres per cow per day (Global Agriculture and Food Security Program, 2016. On the other hand, other countries for example, Israel has a current world record of milk production of forty two litres per cow per day (Agritech Israel, 2018). In Ethiopia, the average milk production is twelve litres per cow per day (Tadesse & Yilman, 2018). The huge difference in milk production capacity of litres per cow per day among EAC member states as well as in comparison to other countries beyond EAC like Israel captures the perspective and it is what motivates this study. So what is it that Israel does in terms of milk production and industrialisation that the milk society in East Africa can emulate in order to improve milk production per litre per cow per day? Therefore, in updating the literature gap, this paper explored milk society and industrialisation in East Africa. The specific objective was to analyze milk production and inclusive mechanisation.

Literature Review

Milk Society

Milk society is defined as milk producing societies (Azad et al., 2002). Society on most literature is linked with knowledge and hence the knowledge society (United Nations, 2005; Kovacevic & Pavlovic, 2016). However, few studies have linked milk with the term society. For example, Azad et al. mentioned that in Bangladesh, there are more than 300 primary milk producing societies. In addition, the study in 2015 by ECDPM indicated that although there is milk production from goats, sheep and camel, the cow milk production is predominant in Eastern Africa region. Therefore, in exploring the milk society, this paper focused on milk production from cows since cow milk production is predominant in East Africa. This paper defines milk society as communities or nations that possess cows for milk production.

Industrialisation

Industrialisation is a terminology, which refers to a shift from subsistence economy that is mainly agricultural to a mechanised system of production, which is efficient and highly technical exploitation of natural resources (Nzau, 2010). Improvements in milk production can be achieved through mechanisation systems like milking machine designs and automated concentrated feeding systems (Samer, 2009). This paper defines industrialisation as large scale production of cow milk through mechanisation of milking the cow and pasture as a feed resource.

Theoretical Background

The dichotomy theory from a motivational aspect has been documented by May and Jarvis (1981). The dichotomy theory assumes motivation in choices between two options as evidenced in past studies, for example, Teja (2013) examined push-pull dichotomy impact on tourism trends and the analysis revealed that foreign and domestic tourists show lesser preferences to other attractions that are located closely to the preferred destinations. Motivation to choices exists in previous tourism studies (Cassar & Munro, 2016; Canosa et al., 2017). The study by Cassar and Munro (2016) examined Malta as a destination from a pilgrim-tourist dichotomy. Equally, this paper is guided by the dichotomy theory in analysing milk society and industrialisation from the relationship of milk production and inclusive mechanisation. In adopting the dichotomy theory, this paper analysed milk production in relation to mechanisation versus non-mechanisation dichotomy by the milk societies.

Review of Literature

From the global perspective, in 2018, Bhabya, Venkatesh, and Thirupathigoud reviewed the dairy farm in India by looking at mechanisation trends. Bhabya et al. found that the use of equipment like tower silos with mechanical unloader among dairy units for purposes of feeding cows is gaining popularity because of changing climate scenarios. Factory farms also known as Concentrated Animal Feeding Operations (CAFOs), which are mostly used by industrialised regions have also been established in Asia (Brighter Green, 2014). In addition, the world population growth as well as income growth in emerging countries will lead to higher demand in the world (IFCN Dairy Report, 2018) which means that enhancing milk production is crucial in order to meet the needs of growing population and income group levels. In Israel, the annual production is almost 1.3 billion litres of cow milk, which is produced by 940 farms and has about 120,000 milking cows of the Israel-Holstein breed (Hojman & Malul, 2012). The milk capacity in Israel for 2012-showed an average annual milk yield per cow as 11,706kgs and this outstanding world-scale achievement was possible due to a combination of factors which are accurate information and professional skills of Israeli dairy farmers (Hojman & Malul, 2012). The report in 2018 by Agritech Israel reveals that average annual milk production per cow increased from 4,000 litres in 1950s to over 15,000 litres in 2018, and this is equivalent to 42 litres per day per cow, which is the highest yield per cow per day record in the world. The increase in milk production in Israel is also attributed to advanced technologies which include computerised milking and feeding systems, cow-cooling systems, equipment and the unique management techniques (Agritech Israel, 2018).

Africa milk production recorded 45.7 million tonnes in 2017 (Food and Agriculture Organization of the United Nations, 2018). Subsequently, Africa's industrialisation models are attractions of Foreign Direct Investments (FDI); vertical diversification; promotion of clusters or groups of

enterprises; promotion of Small and Medium Enterprises (SMEs); and good governance (Tabi & Ondoa, 2011). Although these industrialisation models exist in Africa, the study in Cameroon found that the level of industrialisation from the perspective of manufacturing is affected negatively due to the amount of credit granted to the private sector (Tabi & Ondoa, 2011). Samer (2009) selected review of papers as a research methodology, and concluded that the use of mechanisation, automation and robotisation in milk production helps to save time and labour, provide high efficiency and individual cow care as well as minimum ration losses.

The EAC member states are moving towards industrialisation. For example, in Kenya according to Kittony (2017), the industrial development has improved greatly due to favourable policies and regulations set by government, and further efforts through the adoption of the Kaizen model are being encouraged so that industries in Kenya can benefit in terms of improved productivity, zero defects, low production, team work, minimum capital investment and participatory management. The study by Wambugu, Kirimi, and Opiyo (2011) examined milk productivity in Kenya using descriptive analysis, and found that there were positive trends in milk productivity between 2000 to 2010 in terms of zero grazing systems which perform better than non-zero grazing systems due to several factors which include access to production information.

Furthermore, Wambugu et al. highlighted that the annual milk production in Kenya rose from 2.8 billion litres in 2002 to 4 billion litres in 2009 and this was attributed to government efforts in strengthening and improving milk production through measures like review of policies and regulations. However, current scholars in Kenya have noted challenges such as training and average milk production between counties, women participation in zero-grazing, persistent milk insufficiency for Western Kenya, provision of competent tax policy, lack of inputs and absence of cooling facilities (Gitau, 2013; Mwangi, 2013; Wanjala, Njehia, & Murithi, 2015; Wanjiku, 2017; Adongo, 2018)

Tanzania is also moving from agrarian to a modern industrialised state in 40 years as per the expected industrialisation journey from 2016 to 2056, and also guided by the National Five-Year Development Plan 2016/17-2020/21 (Ministry of Finance and Planning, 2016; Mufuruki, Mawji, Kasiga, & Marwa, 2017). Mufuruki et al. noted that Tanzania imports $ 3.58 billion worth of machines and yet many of these machines could easily be assembled domestically. In promoting sustainable industrialisation, Tanzania implemented a Sustainable Industrial Development Policy (SIDP), which focuses on creating a competitive business environment, improving infrastructure and promoting agriculture-led industrialisation (Policy Research for Development, 2014). In Tanzania, the contribution of the industrial sector to Gross Domestic Product (GDP) is projected to reach 31% by 2025 (Policy Research for Development, 2014).

Although efforts are made towards industrialisation, Maleko et al. emphasised that Tanzania needs to adopt improved feed production by using high yield pasture varieties like napier grass because of decline in milk production of over 40% during the dry season as a result of feed shortages. The study by Maleko et al. found that low adoption of proven technologies to increase milk production during the dry season was due to limited technical know-how by smallholder farmers and suggested that promotion of the proven technologies should include access to information. Similarly, the Global Agriculture and Food Security Program (2016) indicated that the overall milk production yield is approximately two litres per cow per day in Tanzania compared to five litres per cow per day for Kenya. The current statistics show that the annual

milk production in Tanzania is 1.65 billion litres for 2009/2010, and that Tanzania is the third largest livestock country in Africa after Ethiopia and Sudan (Njombe, Msanga, Mbwambo, & Makembe, 2011; Ministry of Livestock and Fisheries Development, 2015). This means that Tanzania is the second largest livestock member state in EAC after South Sudan.

In Uganda, 85% of the milk is produced from indigenous cows mainly Ankole (Wozemba & Nsanja, 2008; Sudhir & Kalule, 2014). Furthermore, Wozemba and Nsanja (2008) mentioned that Uganda's total annual national milk production reached over 1.5 billion litres in 2008 and the increase of milk production is due to growth in the number of cows. However, Elepu (2006) noted that higher productivity per cow is hindered by low adoption of improved technologies. The study by Sudhir and Kalule (2014) stated that milk production in Uganda is mainly for subsistence, and the sector responsible for milk is the dairy sector which has constraints such as feed resources, climate, socio-cultural and marketing. Uganda is transforming towards industrialization and the industrial sector contributed 24% to GDP in 2008/2009 (Mutambi, 2011; Uganda Bureau of Statistics, 2010).

The Uganda Bureau of Statistics (UBOS) indicated that milk production in Uganda between 2015 and 2016 increased from 1,596 million litres to 1,634 million litres (UBOS, 2017). Uganda on average produces eight and a half litres per cow per week (Balikowa, 2011). Mutambi (2011) argues that the industrial development in Uganda can be stimulated through open innovation business incubators as well as upgrading production systems, and introducing new high-tech equipment. The study by Tijjani and Yetisemiyen (2015) concluded that over dependence on family labour is one of the challenges in milk production in Uganda. On the other hand, traditional milking of cows in Uganda as a non-mechanized method of milking cows is used as a cultural tourism resource at Igongo Cultural Centre where there is a museum for displaying and welcoming visitors to experience milking cows using hands thus an additional revenue source (http://www.western-uganda.net/igongo_cultural_centre.html).

Rwanda has focused on milk and milk product sector since 2010 in order to deal with non-tariff barriers like equipment quality control of milk (Rwanda Bureau of Standards, 2010). The mean daily milk production from local breed cow is 1.33 to 4.58 litres per day (Feed the Future, 2016). Cattle for milk production in Rwanda, is characterised by the indigenous Ankole cattle breed (Eugene, 2017). More literature from previous studies in Rwanda cited constraints related to feeds (Kamazi & Mapiye, 2012, Feed the Future, 2016, Eugene, 2017).

The industrial sector in Rwanda contributes 17.6% to GDP (World Factbook, 2018). There has been a gradual shift from free-range to zero-grazing and feed management for purposes of improving milk yields in Rwanda but there are also no adequate information on management practices, feed resources and feeding practices (Eugene, 2017). The study by Eugene (2017) deployed qualitative approach and found that napier grass was mostly planted (93.2%) but legumes were rare (2.5%) hence recommended for improvement of pastures and introduction of legumes as a way to tackle the challenges of shortages of feeds. A similar study showed that in 2013, Rwanda's average milk production was 188 million litres annually, which was low compared to other EAC member states due to a number of challenges including good quality pastures (Nyamwaro et al., 2018). However, the study by ECDPM (2015) mentioned that Rwanda milk production is expected to rise due to favourable policy, institutional environment and investments by the government as well as development partners.

According to the Ministry of Agriculture and Livestock of Burundi (2012), one of the activities to increase animal feed was the installation of fodder crop fields. In 2012, milk production in Burundi was 31.8 million litres (Lokuruka, 2016). At least 90% of cows in Burundi are Ankole breed with many farmers facing constraints of limited access to animal feed as a result of reduction of natural pastures (Ndumu et al., 2008; Desiere, Niragira, D'Haese, & Vellema, 2015). The industrial sector in Burundi contributes 16% to GDP (World Factbook, 2018). Apart from aiming towards industrialisation through EAC industrial policy, the study by Desiere et al. indicated that Burundi's agricultural investment plan for year 2012-2017 was to distribute 200,000 cows to smallholder farmers.

South Sudan has the largest population of 17,729,188 cattles in 2014 (Emmanuel, Tijjani, & Cakir, 2018). Past researchers have also contributed on studies related to milk production in South Sudan (El-Hag et al., 2011; Mohammed, Fager, Abu, Abdelwahid, & Abu, 2016). According to Mohammed et al. the indigenous cattle breeds of South Sudan are Nilotic cattles, which are descendants of ancient crossbreeds between hamitc and zebu. Additional literature shows that the average yield for indigenous breeds in South Sudan in 2013 was 1.25 litres per cow per day while the total national volume of milk production was 256 million litres (Onyango, Oyoko, Too, & Masake, 2015). Munyua (2015) indicated that in 2013, milk production from cattle for South Sudan was 351.17 million litres. In South Sudan, the contribution to GDP by the industrial sector in 2011 was 20.3% (Africa Economic Outlook, 2012). South Sudan as EAC member state is also guided by EAC industrial policy. However, Emmanuel et al. indicated that although South Sudan has the largest cattle population, pasture is one of the major challenges due to climate, land use and land tenure.

The empirical literature review shows that Kenya, Tanzania, Uganda, Rwanda, Burundi and South Sudan as milk societies have varying milk production capacities and as EAC member states aim towards industrialisation. Although most studies have documented milk production and industrialisation, there is rare discussion on milk production and inclusive mechanisation in the context of East Africa. Therefore, this paper explores the relationship of milk society and industrialisation in East Africa by analysing milk production and inclusive mechanisation.

Methodology

Documentary research method approach using literature analysis was deployed in this study to explore milk society and industrialisation by analysing milk production and inclusive mechanisation. The paper focuses on Kenya, Tanzania, Uganda, Burundi, Rwanda and South Sudan as the member states of EAC. This paper utilized journal articles, conference papers, reports, websites, projects and theses to obtain information on milk society and industrialisation. This study is limited to documentary research method approach and literature analysis for purposes of exploring milk society and industrialisation in East Africa. From the literature (NBS, 2016; Nyamwaro et al., 2018; BOT, 2017; UBOS, 2017, 2018; Oneal, 2019), this study compiled milk production trends for EAC member states as noted in Table 1 for purposes of analytical comparisons among EAC member states.

Table 1: Milk Production (Million Litres) from 2000-2018 for EAC Countries

Year	Kenya	Tanzania	Uganda	Rwanda	Burundi	South Sudan
2000	2,224.00	710.00	511.00	106.45	18.55	-

2001	2,512.58	814.00	525.00	125.90	19.50	-
2002	2,890.68	900.50	700.00	112.00	19.25	-
2003	2,898.45	980.50	940.45	112.46	14.79	-
2004	3,392.40	1,180.00	995.75	121.41	14.34	-
2005	3,752.20	1,386.40	1,032.50	120.00	16.15	-
2006	3,700.08	1,412.78	1,050.00	144.88	11.86	-
2007	3,202.38	1,422.21	1,085.00	166.73	19.64	-
2008	3,208.94	1,500.00	1,120.00	145.00	26.17	-
2009	3,567.24	1,604.13	1,155.00	145.00	24.72	-
2010	3,638.59	1,649.86	1,190.00	183.00	30.42	-
2011	3,711.36	1,738.68	1,190.00	184.00	43.84	-
2012	3,732.96	1,853.09	1,207.50	186.00	31.80	-
2013	3,750.00	1,921.64	1,207.50	188.00	41.09	351.17
2014	-	1,990.00	1,549.00	-	-	-
2015	3,444.00	2,058.00	1,596.00	-	-	2,629
2016	-	2,127.00	1,634.00	-	-	-
2017	4,115.00	2,249.00	1,614.00	-	-	2,630
2018	-	-	1,800.00	-	-	-

Source: Compiled from Munyua (2015), National Bureau of Statistics (2016), Nyamwaro et al. (2018), BOT (2017), UBOS (2017, 2018), Emond (2018), Oneal (2019)

In comparing milk production to other best milk producing countries, Table 2 and Table 3 indicate comparative data. Table 2 shows EAC member states versus top five best milk producers (India, USA, New Zealand, Turkey and Netherlands) for milk production increase in million litres from 2011 to 2016. Table 3 is a compilation of milk production per litre per cow per day to show comparisons among EAC countries as well as compared to few other best milk producing countries with data sourced from Balikowa (2011), Onyango et al. (2015), Global Agriculture and Food Security Program (2016), Agritech Israel (2018) and Tadesse and Yilman (2018). Table 1, Table 2 and Table 3 assist this study in the discussion section for milk production differences among EAC member states.

Table 2: Milk Production (per litre per cow per day) for EAC members compared to other best milk producing countries

EAC Member States	**2011 to 2016 million litres of milk increase**
Kenya	267.36
Tanzania	388.32
Uganda	444.00
Rwanda	4.00
Burundi	-1.94
South Sudan	2,777.83
Top Five: World milk producers	
India	23,915.85
USA	7,344.14
New Zealand	3,777.67
Turkey	2,983.84
Netherlands	2,682.57

Source: Compiled from Munyua (2015), National Bureau of Statistics (2016), Nyamwaro et al. (2018), BOT (2017), UBOS (2017, 2018), Emond (2018), Weinert (2018), Oneal (2019).

Table 3: Milk Production (per litre per cow per day) for EAC members compared to other best milk producing countries

EAC Member States	**Milk Production (per litre per cow per day)**	**Source**
Kenya	5	Global Agriculture and Food Security Program (2016)
Tanzania	2	Global Agriculture and Food Security Program (2016)
Uganda	1.2	Balikowa (2011)
Rwanda	4.5	Feed the Future (2016)
Burundi	-	-
South Sudan	1.2	Onyango et al. (2015)
Other best milk producing countries		
Ethiopia	12	Tadesse and Yilman (2018)
Israel	42	Agritech Israel (2018)

Discussion of Findings

The Table 1 reveals that milk production overtime for the milk societies of EAC member states had been increasing. Kenya's milk production increased from 2, 224 million litres in 2000 to 4,115 million litres in 2017; Tanzania's milk production rose from 710 million litres in 2000 to 2,249 million litres in 2017; Uganda has witnessed milk production increase of 511 million litres in 2000 to 1,800 million litres in 2018; Rwanda's milk production over time has increased from 106. 45 litres in 2000 to 188 million litres in 2013; Burundi's milk production has also risen from 18.55 million litres in 2000 to 41.09 million litres in 2013; according to available data, South Sudan's milk production rose from 351.17 million litres in 2013 to 2,630 million litres in 2017. Although milk production has been increasing for EAC member states, differences are noted in that Kenya is leading all other EAC member states. The reason for the differences in milk production is based on the fact that Kenya has embarked on industrialisation, which is heavily supported by the government through favourable policies and regulations as well as the initiative to adopt the Kaizen model so that industries in Kenya can have improved productivity. The common reason for low annual cow milk production for other EAC member states is the feed resources due to low adoption of improved technologies on pasture to achieve higher productivity.

The records from the literature in Table 2 indicate that all EAC member states witnessed increase in milk production for the past five years from 2011 to 2016 except for Burundi which showed negative meaning there was a decrease of 1.94 million litres. The decrease in milk production for Burundi is supported by studies from various scholars (Ndumu et al., 2008; Desiere et al., 2015) who commonly cited the major constraints in milk production is animal feed. In comparing EAC member states to top five best milk producers for the past five years of 2011 to 2016, Table 2

shows that although majority of EAC member states increased milk production but the milk production is low compared to India, USA, New Zealand, Turkey and Netherlands. For instance, South Sudan showed the highest increase from 2011 to 2016 of 2777.83 million litres but this very low compared to India which recorded 23, 915.85 million litres and thus a huge difference indeed. One of the major reasons for the huge difference in increase of milk production is because India has embarked on mechanisation of milk production by using tower silos with mechanical unloader to feed cows. However, there is an exception of South Sudan (milk production increase of 2,777.83 million litres from 2011 to 2015 for the available records) which performed better than the Netherlands (milk production increase of 2,682.57 million litres). The reason for South Sudan to perform better than Netherlands is due to South Sudan being endowed with a large population of cattle despite the common challenges of milk production such as climate and animal feed.

In comparing per litre per cow per day for milk production among EAC countries as well as with other countries, Table 3 shows that Kenya has highest per litre per cow per day milk production among EAC member states. Although Kenya ranks highest followed by Rwanda, the record in per litre per cow per day milk production is still very low compared to Ethiopia and Israel. While Kenya ranks high in per litre per cow per day for milk production among EAC members due to attributes such as policies and government support, there is a need to enhance milk production per litre per cow per day by engaging in management techniques and high-tech equipments since these are among the strategies that Israel performs to achieve world record per litre per cow per day. Other EAC member states can also follow this example in order to enhance milk production capacity on the basis of per litre per cow per day.

Further literature reveals that technologies need to be adopted at farm level by smallholder farmers through promotion of available technologies such as access to information on improved feeding using napier grass. On the other hand, Rwanda applies napier grass extensively but legumes are rare and hence emphasis for improvements and increase milk production is on access to information. This suggests that smallholder farmers have limited access to technologies. The overall analysis shows that the milk societies in East Africa have unique strengths as cow milk producers which can be highlighted as Kenya having the highest annual milk production; South Sudan has the largest number of cows followed by Tanzania; while Uganda, Rwanda and Burundi are endowed with Ankole cows. Uganda is noticeable for the recently innovative way of using traditional milking of cows by hands as a cultural tourism attraction at Igongo Cultural Centre in Mbarara.

In terms of milk production in relation to inclusive mechanisation, the literature analysis show that technology and equipment adoption are low and therefore, smallholder farmers need to have access to information. Balikowa (2011) noted that lack of equipment is one of the challenges in milk production and this analysis differs from the articles by Samer (2009) and Agritech Israel (2018) which showed that milk production combined with milking machine design and availability of high-tech equipment such as automated milking systems can improve the per cow per day yield.

Conclusions and Implication

This study can conclude that although milk societies are evident in all East African member states where cow milk production is predominant, milk production varies among the East Africa

nations due to a number of reasons such as policies, regulations and type of cow. For example, on the type of cow among the milk societies, Uganda, Rwanda and Burundi have long horned Ankole cows while in Tanzania is the shorthorn East Africa zebu. Further differences are noted from the milk production per cow per day which is 5 litres per cow per day in Kenya while Tanzania produces 2 litres per cow per day. The variation in milk production per litre per cow per day is because of feed shortage during the dry season for Tanzania. Uganda's average milk production is 1.2 litres per cow per day. Overall, Kenya's milk yield per litre per cow per day is greater than other EAC member states.

Similarly, the per cow per day milk production for the milk societies in East Africa differs not only within the East African countries but in comparison to Ethiopia which produces 12 litres per cow per day while Israel as the world leader in milk production yields 42 litres per cow per day. Therefore, in enhancing milk production among EAC member states, are for the milk societies in East Africa to learn from each other. For example, having large cattle population enables South Sudan to produce more milk despite common challenges like shortage of animal feed and climate. EAC member states can also enhance their milk production at farm level by learning from Israel on how to improve milk production per cow per day through management techniques and high-tech equipment such as robotic milking. At policy level, EAC member states can initiate exchange training programs where producers at farm level can learn how other countries such as Ethiopia and Israel perform better in milk production so as to adopt and customise training skills to the needs of milk production according to each member state.

The mechanisation versus non mechanization dichotomy implies that mechanisation in terms of equipment like milking machine designs as well as mechanised pasture feeding systems can assist smallholder farmers to improve productivity as well as reduce the dependence on family labour. On the other hand, non-mechanised or traditional milking of cows using hands should be maintained and sustained because of the major role in additional revenue sources through cultural tourism for the milk societies as evidenced at Igongo Cultural Centre in Mbarara region of Uganda where tourists both local and international can experience traditional milking of cows. Hence, the relationship of milk societies and industrialisation in the context of East African countries of Kenya, Tanzania, Uganda, Burundi, Rwanda and South Sudan should improve milk production per cow per day by embracing both mechanised and non-mechanised milking and feeding systems among smallholder farmers.

Enhancing milk production among EAC member states is important and this is due to expected population growth not only in Africa but the world. Growth in population will lead to demands in various foods including milk. Therefore, milk production can be a source of food security for the milk societies.

Limitations of this paper are on methodological approach of documentary method with literature analysis and confined within EAC member states. Future researchers can extend methodological approach by utilising cross-sectional and longitudinal designs to examine the milk society and regional trade.

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