



ORIGINAL ARTICLE

Sri Lanka's Dairy Sector: Where to Move and What to Do – Prediction and a Trend Analysis

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DOI: <http://doi.org/10.4038/sljae.v4i1.74>

Abstract

Sri Lanka is currently producing only about 40% of its milk demand domestically and thus heavily depends on imports to cater for the demand. To attain self-sufficiency in milk, policy formulation and executing appropriate measures in dairy development at the field level are much needed. In this context, this study was conducted to identify recent trends in the dairy sector, modelling dairy production and milking animal populations and suggest potential policy requirements to boost the dairy sector in Sri Lanka. The data on cow and buffalo milk production and population during the last five decades were gathered and a series of trend analyses were conducted using linear, exponential, cubic and quadratic trend models. The best-fitting trend model for each time series was then selected based on the adjusted R-square (R^2) value. Trend analysis showed that there are increasing trends in milking cow and buffalo populations, and milk production over the years. As policy implementation, it is important to increase the supply of domestic livestock produce at competitive prices for consumers. There is a great potential for producing milk from buffaloes which has not been exploited in Sri Lanka. Small scale milk processing should be encouraged as the output of such producers, probably when the price of powdered milk increases in the international market.

Keywords: Buffalo, Cow, Dairy, Milk, Sri Lanka

1. Introduction

Livestock plays diverse roles in Sri Lankan agriculture, contributing around 1% to the national Gross Domestic Production (GDP) at present. Primarily, they provide a crucial source of high-quality protein in terms of milk, meat and eggs. However, the dairy sector has been identified as the priority sector for development among other livestock sub-sectors in the country. National Accounts of Sri Lanka (2019) shows the contribution of the dairy industry to the GDP in Sri Lanka is 21%. Among different livestock species, cattle and buffaloes are regarded as the major animals that play a momentous role in the dairy industry. Traditionally, these animals are reared for multiple purposes such as to obtain milk for household consumption, as a medium for transportation and draft, and dung as an organic fertilizer and fuel. Presently, it has become one of the major employment for rural poor which generates a continuous flow of income.

There are 307,180 and 25,338 registered cattle and buffalo farms in Sri Lanka, respectively. The highest number of cattle farms have been recorded in Eastern, North Western and Northern provinces whereas, the Eastern, Southern and North Central provinces recorded the highest number of buffalo farms (Livestock Statistical Bulletin

2019). In addition, the rearing of few animals by villagers could also be seen commonly in most of the rural areas in Sri Lanka. However, Sri Lanka produces only 40 percent of the total milk requirement of the country and the remaining 60 percent of milk and dairy requirement depends on imports (Livestock Statistical Bulletin 2019).

According to the Department of Animal Production and Health (DAPH 2019), Sri Lanka exported only about 1,366 metric tons (Mt) of milk and milk products in 2019 while importing 98,837 Mt of milk and milk products spending nearly 282 million US dollars. These imported milk products include milk and milk cream, milk cream fat, condensed milk, cheese and curd, butter and other fats, buttermilk and curdled milk and whey and whey powder. Interestingly, Sri Lanka stands in the fourth position in the world, in terms of importing powdered milk mainly from New Zealand. The average cost of production of fresh milk in Sri Lanka was 51.11 Sri Lankan rupees (LKR) under intensive management system and the average retail price was Rs.69.96 per litre (DAPH Annual Reports 2019).

Cow milk production represents approximately 82% of the world milk production. Asia is the world's largest milk producer (202 million tonnes), whereas the

European Union (EU) and North and Central America produced around 164 and 123 million tonnes of milk, respectively (Bulleting of the International Dairy Federation 2017). According to Delgado et al. (1999), during recent years, there has been a rapid increase in the consumption and demand for milk, particularly in the developing countries which is termed as the “livestock revolution”. In comparison, the milking cow and buffalo populations in Sri Lanka were estimated at 0.67 million and 0.16 million heads, respectively in 2019 (Department of Census & Statistics 2019). It amounts to annual cow milk production of 354.5 million litres (83.9%) and buffalo milk production of 67.5 million litres (16.1%) which accounts for total milk production of 422.1 million litres (Department of Animal Production & Health 2019). Per capita availability of milk and milk products was about 52 kg/year which amounted to a slight reduction compared to the last two years. It is less valuable when compared with other countries in the South Asian region. Therefore, it is highly important to develop the dairy industry in the country.

With this background, it is vital to identify the link between total milk production and the current population of dairy cows and

buffalo. In addition, there should be a clear image on the milk consumption and requirement within the country and quantity of imports to meet the requirement to determine the future in the milk industry of Sri Lanka. The key objectives of this research are to identify recent trends in dairy sector, model dairy production and milking animal populations and suggest potential policy requirements to boost the dairy sector in Sri Lanka.

2. Materials and Methods

Data collection

Annual time series data on cow and buffalo populations and milk production in Sri Lanka were collected from the Department of Animal Production & Health (DAPH) and the Department of Census and Statistics of Sri Lanka. The time series comprised data from the period, 1970 to 2019.

Trend Analysis

To identify the most suitable trend of the time series data, a series of trend analyses was conducted using linear, exponential, cubic and quadratic trend models. The models were estimated using the Statistical Package for the Social Sciences, SPSS (IBM Corp. released 2012. IBM SPSS Statistics for Windows, Version 16.0. Armonk, NY: IBM Corp.). The best-fitting

trend model for each time series was then selected based on the adjusted R-square (R^2) value.

Forecasting of the Time Series

The forecasts for the next five years (2020 – 2024) corresponding to each time series were estimated using Holt's Linear Method through SPSS Expert Modeler.

3. Results and Discussion

Historical trends in dairy cattle populations and milk production

Since it was important to identify the trend in each variable, time series data were plotted on cow population, buffalo population, cow milk production and buffalo milk production (Fig. 1).

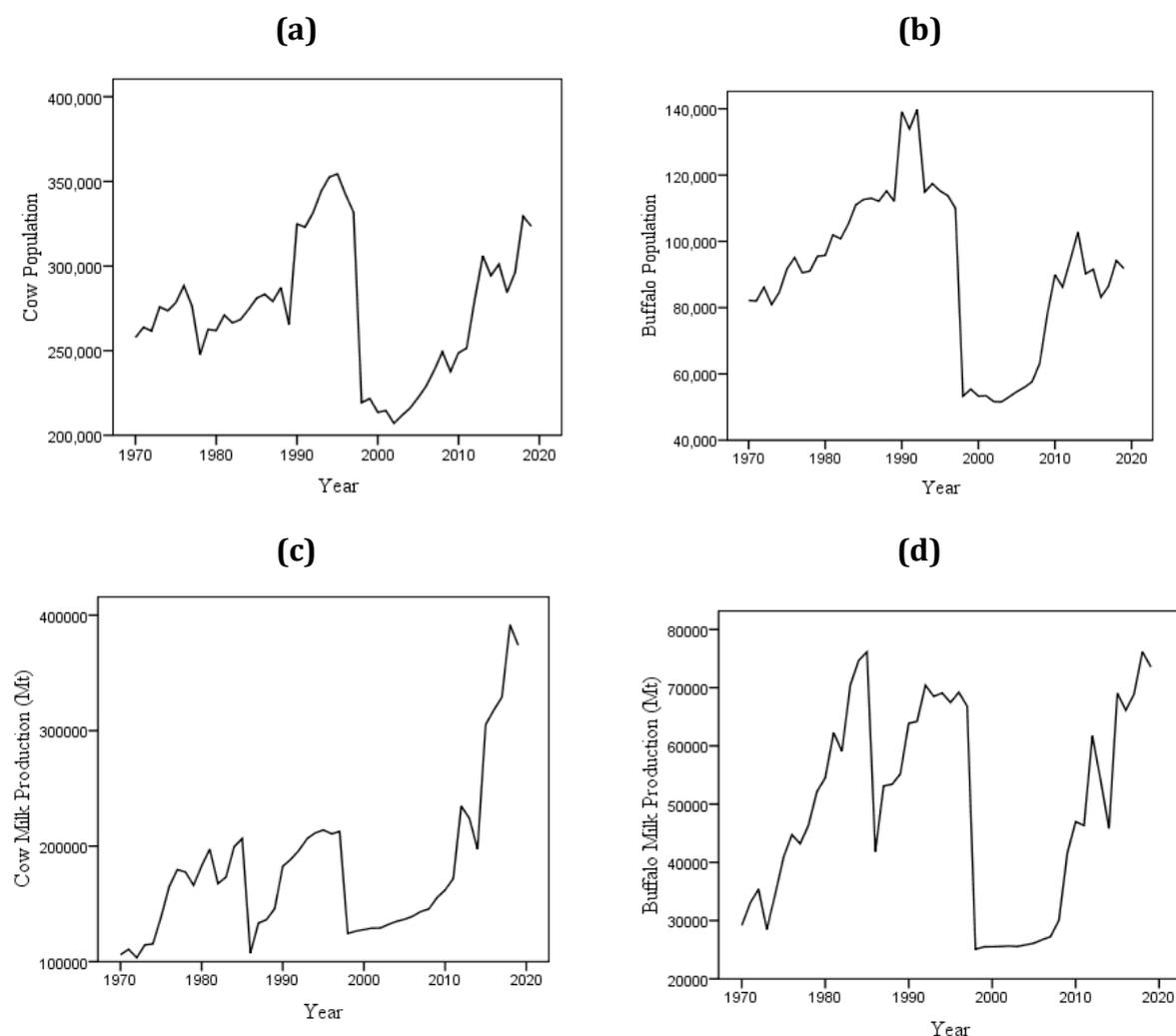


Figure 1. Time series plot of (a) Cow population, (b) Buffalo population, (c) Cow milk production, (d) Buffalo milk production

In general, each graph plotted above showed increasing and decreasing trends with multiple peaks. Both cow and buffalo populations have dropped drastically around the year 2000. In contrast, both cow and buffalo populations, as well as the milk production, have increased continuously after 2000. The reasons for such

fluctuations are discussed later in the test.

The most fitted-trend for each time series was identified by analysing data fitted into trend models. Fig. 2 shows the corresponding model (Linear, Exponential, Cubic and Quadratic) fitted into each time series. Summaries and parameters estimated in alternative models are given in Table 1.

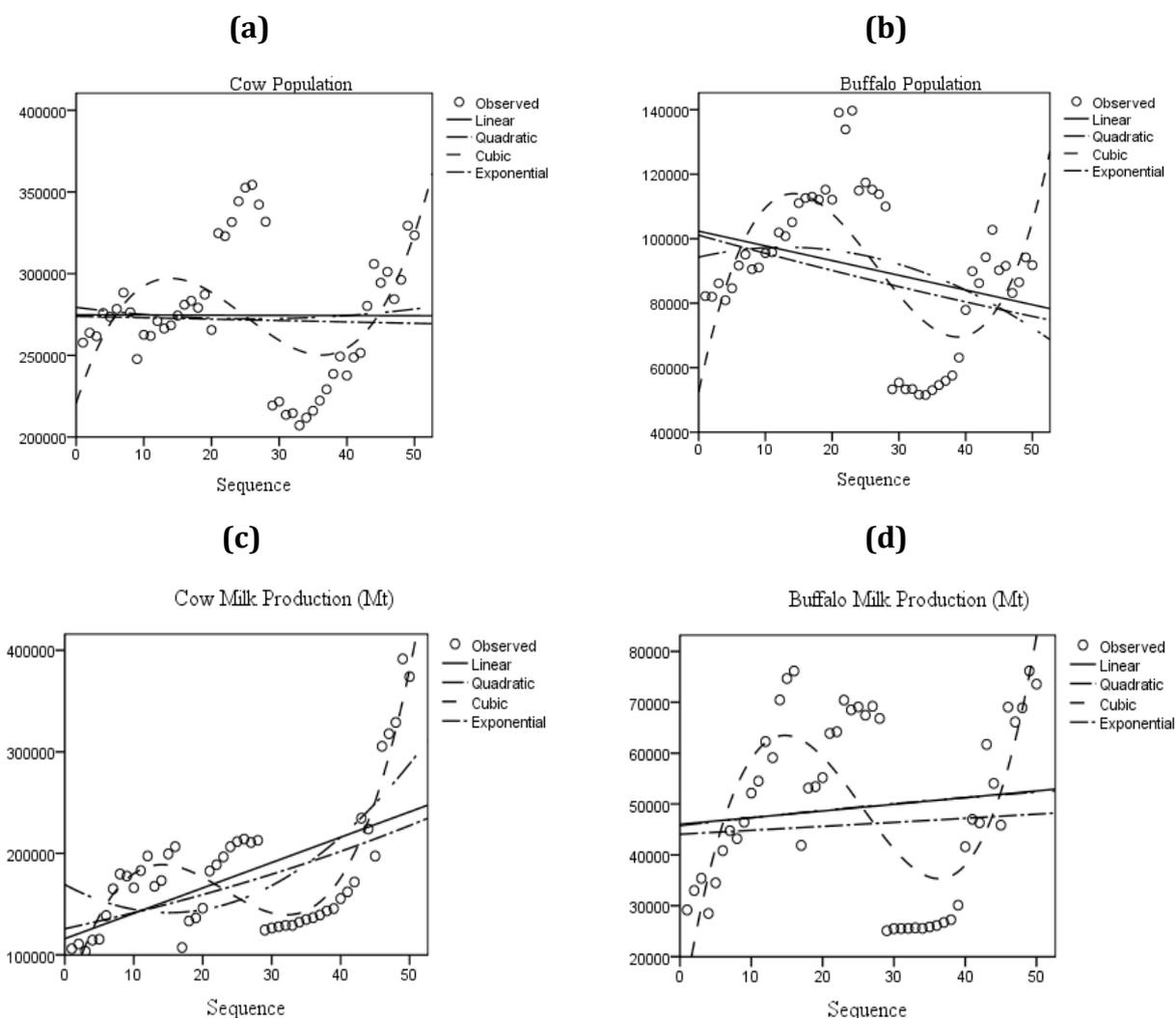


Figure 2. Time series data fitted into linear, quadratic, cubic and exponential trend models, (a) cow population, (b) buffalo population, (c) cow milk production, (d) buffalo milk production.

Best-fitting trend model for a particular variable was chosen based on the R^2 value. Accordingly, the model with the highest R^2 value was chosen as the best-fitting model among the alternative models. Cubic trend model provided a

better fit to all the time series; cow population, buffalo population, cow milk production and buffalo milk production being the model with the highest R^2 value.

Table 1. Model summaries and parameters for the alternative trend models corresponding to the time series of cow population, buffalo population, cow milk production and Buffalo milk production

Parameter	Model	Model Summary					Parameter Estimates			
		R^2	F	df1	df2	Sig.	Constant	β_1	β_2	β_3
Cow population	Linear	.000	.001	1	48	.979	2.748E5	-10.406		
	Quadratic	.002	.057	2	47	.945	2.794E5	-540.84	10.401	
	Cubic	.250	5.120	3	46	.004	2.207E5	1.262E4	-628.458	8.351
	Exponential	.001	.047	1	48	.828	2.739E5	.000		
Buffalo population	Linear	.078	4.054	1	48	.050	1.023E5	-		
								456.314		
	Quadratic	.099	2.571	2	47	.087	9.427E4	474.198	-18.245	
	Cubic	.453	12.678	3	46	.000	5.239E4	9.867E3	-474.145	5.959
	Exponential	.086	4.489	1	48	.039	1.011E5	-.006		
Cow milk production	Linear	.304	20.959	1	48	.000	1.160E5	2.498E3		
	Quadratic	.422	17.139	2	47	.000	1.693E5	-3.651E3	120.586	
	Cubic	.792	58.221	3	46	.000	5.060E4	2.296E4	-1.171E3	16.883
	Exponential	.287	19.340	1	48	.000	1.257E5	.012		
Buffalo milk production	Linear	.012	.580	1	48	.450	4.600E4	131.320		
	Quadratic	.012	.285	2	47	.754	4.576E4	159.787	-.558	
	Cubic	.583	21.404	3	46	.000	6.663E3	8.927E3	-426.102	5.563
	Exponential	.004	.200	1	48	.657	4.406E4	.002		

According to Fig. 3, cow milk production has shown a significant increase in year on year basis comparison to buffalo milk. This

result may be explained by the data in Fig. 1 and reveals the relationship between the increasing cattle population and cow milk

production. A slight decline in both cow and buffalo milk production is observed in 2015 and 2019. The main reason may be the foot and mouth disease outbreak in the middle of the year. Foot-and-mouth disease is spreading among cattle in the Kurunegala and Puttalam districts, and so far, around 85,000 cows have been affected (Daily News e-paper 2019). Milk production

decreased by 6.3% (448 million litres) in 2019 compared to the growth of 20.5 per cent recorded in the previous year. Cow milk production declined by 4.5% (374 million litres). Whereas, buffalo milk production declined by 14.4% (73.6 million litres), which resulted from lower total milk production in the respective year (Central Bank Reports 2019).

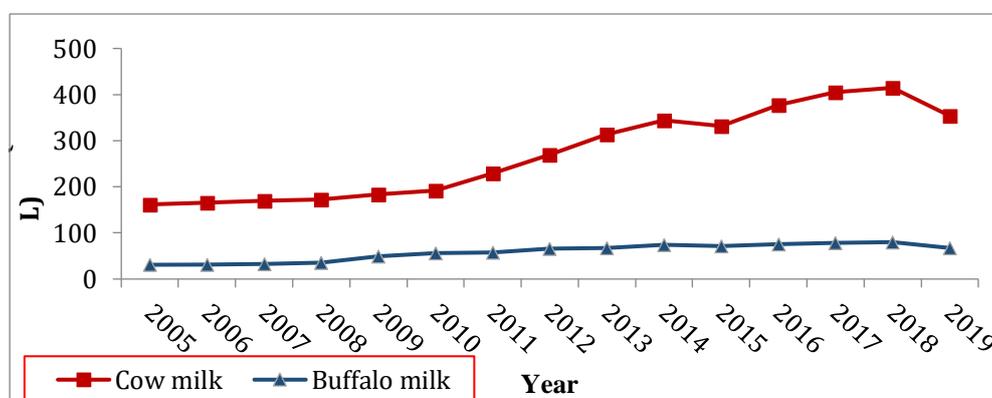


Figure 3. Variation in milk production over the last 15 years in Sri Lanka

A large amount of milk and milk products were imported to Sri Lanka to meet the market demand. It showed in Fig. 4, the import of milk and milk products has increased gradually when compared with the production. Moreover, during the period 2013-2014, there was a slight decline in milk imports which resulted in a slight increment in milk production comparatively. Government strategies to improve the dairy sector and make it popular among people have resulted in a

progressive trend of consumption of milk and milk products.

However, at present Sri Lanka is self-sufficient in about 40% of domestic milk production and the balance of 60% is required to import to fulfil the domestic requirements. Therefore, imports of dairy products play a vital role in the Sri Lankan dairy sector. Less consumption of Fresh milk has resulted in a higher demand for powdered milk in Sri Lanka since fresh milk is more expensive and unavailable than powdered milk. There are huge campaigns

to promote imported milk powder in different brand names by the private sector companies. Therefore, the majority of the consumers are dependent on imported milk products, and it is caused to drain out large

amounts of the much-needed foreign exchange from the country.

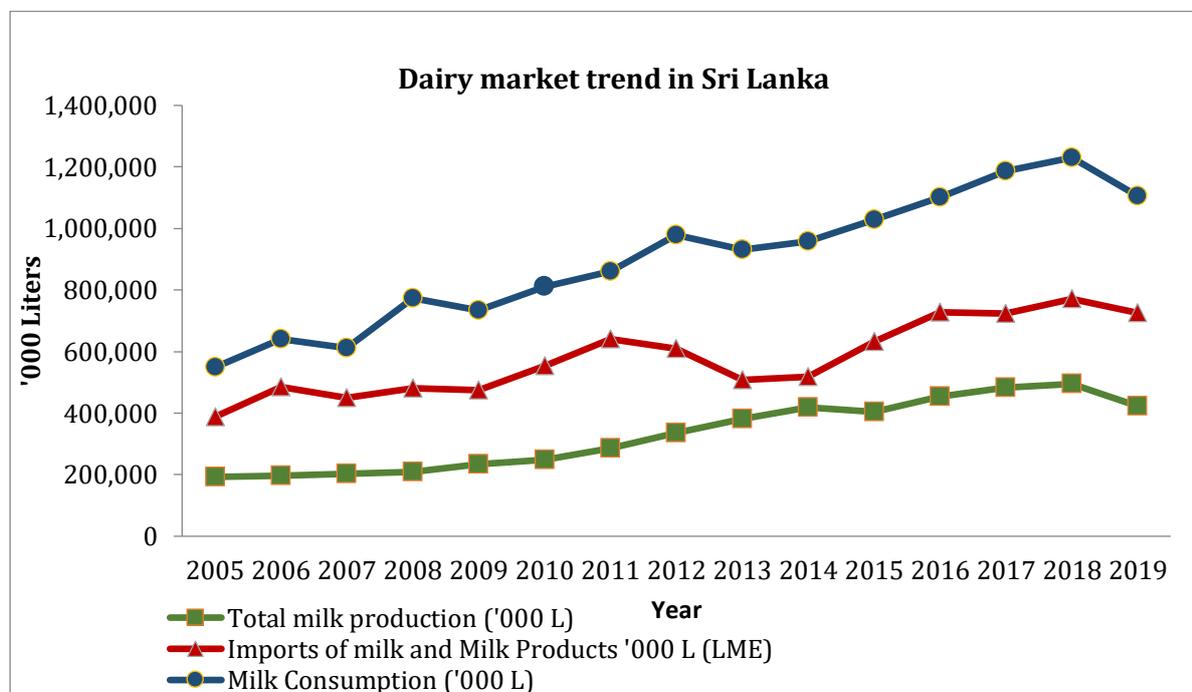


Figure 4. Total milk production, Imports and Consumption of milk from 2005-2019

Cow population

The majority of cattle in the country are of the crossbred type, comprising mainly of crosses between the indigenous, *Bos indicus* (Zebu) cattle and Zebu breeds from the Indian sub-continent, or between Zebu and *Bos taurus* (temperate) dairy breeds. The main improved Zebu breeds used in dairy production in Sri Lanka are Sindhi and Sahiwal, while the main European breeds used are Holstein/Friesian and Jersey (Perera & Jayasuriya 2008). As per the

statistical data available, the highest cattle population can be seen in Kurunegala, Batticaloa, Anuradhapura, Ampara and Vavuniya districts in 2019.

Much political decisions were held from time to time to implement programmes to develop the livestock sector in Sri Lanka. Additionally, various reasons were affected caused to the fluctuation of cow population from time to time.

There was an increase in the population during the first decade starting from 1970

and a sudden drop was observed by 1980. This may be due to the introduction of the open economy concept to the country. Before the economy's opening in 1977, domestic sources of milk provided nearly 80 percent of Sri Lanka's consumption needs (Ranaweera 2007).

The second decade starting from 1980-1990 showed slow growth in cow population in Sri Lanka. A significant increase was observed in the cow population from 1990 including the highest milking cow population of 350,000 animals observed in 1993. In contrast, the cow population in 1997 showed drastically drop basically due to the civil war condition prevailed at that time in the country. Moreover, after 2000, there was a marked upward trend in cow population and after the civil war in 2009 there was a significant positive linear improvement.

On the other hand, the decision that was taken to ban slaughter of female cattle and buffaloes in 1988 led to increasing the number of cow population (Animal (Amendment) Act 1988). Although, the move was deemed primarily due to the influence of the majority Buddhist population, the government ruled out the religious impact and insisted that the cattle slaughter ban is to save the draught animals from going to the beef trade for use as farm

power with secondary impacts on the local milk industry (Sirinivasan 2020). However, this decision too has not been able to save the decline in the national cattle herd. The time series plot in Fig. 1(a) and (b) also emphasises the same scenario. In addition, several international and national programmes were launched spending with colossal amount of money to improve the dairy infrastructure and the cattle population for milk production. Accordingly, National Livestock Development Board (NLDB) imported 2,000 European type high yielding heifers in 2012/2013, under the Dairy Development Project Phase I, and accommodated in three NLDB farms in upcountry (Bopaththalawa, Dayagama and Manikpalama). Produced calves had been issued to the interested farmers having appropriate infrastructure facilities. Later they imported another consignment of 2,500 pregnant heifers from Australia and allocated them at Ridiyagama farm located in the southern province in 2015 (NLDB 2020). In 2017 another consignment of 5000 pregnant heifers were imported from Australia (n=3000) and New Zealand (n=2000), were sold at a concessionary rate among interested medium-scale (10 heifers/farm) and large scale (100-350 heifers/farm) entrepreneurs in many parts of the country, primarily in Nuwara Eliya,

Matale, Kandy, Kurunegala and Badulla districts. Therefore, it can be concluded that the government policies discussed above coupled with other infrastructure developments were affected for the upward and downward trends in the time series data plot of the cow population in the current study.

Buffalo population

Over 90% of the buffalo (*Bubalus bubalis*) population is of the indigenous type, referred to as 'Lanka buffalo', kept by smallholder farmers (Perera and Jayasuriya 2008). As per the details of Department of Census and Statistics, the highest buffalo population can be observed in Hambanthota, Trincomalee, Monaragala, and Anuradhapura districts.

It can be observed a similar sort of trend patterns, as illustrated for the cattle population in Fig. 1 (a). Both cow and buffalo population variations were analysed for 49 years from 1970-2019. Buffalo population increased gradually during the first two decades from 1970. It seems possible that this trend is due to the land availability for free grazing and adequate feeding materials, in addition to the reasons about the increasing of cow population mentioned above.

From 1981 to 1997 the buffalo population has been remarkably decreased similar to the cow population. This may be due to the higher mortality rate prevailing in the field. Although, the slaughter of buffaloes was prohibited until recent times, illicit slaughter for human consumption can be the main reason for the reduction in the buffalo population.

Moreover, in Sri Lanka, buffaloes have traditionally been used for work in connection with paddy fieldwork. Following the introduction of tractors in the 1940s and the invention (in Sri Lanka) of the two-wheeled "hand tractor", the use of buffaloes for paddy field work has declined markedly. Together with this, the number of buffaloes have dramatically reduced whereas, in those countries in which they are used for milk, the numbers have increased (Ranawana 2008).

Both cattle and buffalo populations show a significant increment after the ceasing of war in 2009. Therefore, it can be revealed that the civil war has highly affected domestic milk production before 2009. However, it is significant that cow milk production is higher in Sri Lanka when compared to buffalo milk production.

Cow milk production

Cow milk production is the key factor that controls the dairy industry in Sri Lanka. According to the government statistical data, there were 354 million litres of production in the year 2019. Per-capita availability was recorded as almost 160 mL per day in the year 2018 which account for 54 L per year.

Although there were decreasing trends observed several times, overall cow milk production has recorded positive growth. During the last decade, especially after 2008, there was a remarkable increase in cow milk production. This growth was supported by various initiatives in addition to government policies related to the industry. After the importation of 2,500 cattle, Ridiyagama farm became as the largest dairy farm in Sri Lanka which could produce approximately 10 million litres of milk annually from the year 2016. After completion of both phases I & II of the Sri Lanka Dairy Development Project, the total annual milk production of NLDB has increased up to 14 million litres from 3 million litres by end of year 2018. The overall current contribution of NLDB to the national production is around 4% by end of 2018. These literature findings further support the current trend analysis depicted in Fig. 1 where it describes with the

increase of the population, milk production has also been increased.

Moreover, upgrading the chilling centre facilities of large, medium and small milk collectors, trade of milk powder, veterinary services, forage availability, cattle management practices, increased contribution from the Northern and Eastern Provinces, the provision of financial assistance, the stabilization of remunerative farm-gate prices, provision of high-yielding cows, the promotion of liquid milk consumption by the government, and the diversification of income-generation avenues of the people can be considered as other reasons for the growth of the dairy industry. It is observed that milk production is on par with the cow population.

Buffalo milk production

Around 15% of milk produced in the world is from buffaloes and the major contribution is from India and Pakistan. In contrast, the contribution of buffalo milk to the overall national milk production in Sri Lanka is around 16%.

Buffaloes have several advantages over cattle for milk production under our conditions. They can effectively utilize large amounts of coarse forages when compared to improved dairy cattle. This ability is due

to a larger and stronger rumen, non-selective feeding habits, well developed salivary glands as well as the ability to absorb and excrete large amounts of water (Ranawana 2008). Buffaloes are also able to live and thrive in low-lying waterlogged areas. They have other advantages such as producing richer milk and being more resistant to diseases. The only disadvantage is that they are sluggish breeders and Artificial Insemination is more difficult. However, there is a great potential for producing milk from buffaloes which has not been exploited in Sri Lanka.

Prospects for increasing milk production

Milk consumption in Sri Lanka was estimated to be approximately 29 kg per person in the year 1998. In comparison, per capita availability of milk and milk products has been increased progressively

in the last decade (Fig. 5). The annual per capita consumption of milk in the developed countries is 200 kg or more and it is much higher than the developing countries. The annual per capita consumption of milk in developing countries is about 40 kg (Ranawana 2008). The per capita consumption of milk and milk products is higher in developed countries, but the gap with many developing countries is narrowing. The share of fresh dairy products in the world of global consumption is expected to increase over the coming decade due to stronger demand growth in India and Pakistan in particular, which in turn is driven by income and population growth. World per capita consumption of fresh dairy products is expected to increase by 1.0% p.a. over the coming decade (FAO).

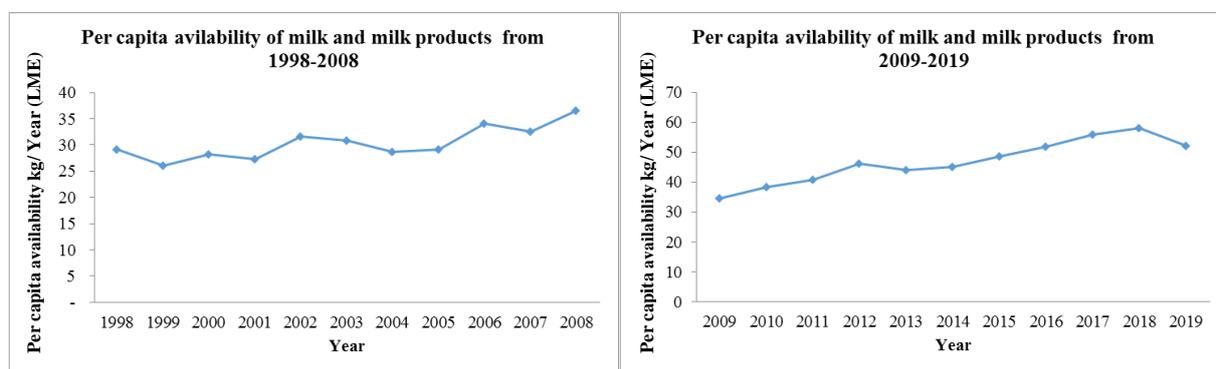


Figure 5. Per capita availability of milk and milk products during past two decades (from 1998-2019)

Since the early 1960s, per capita milk consumption in developing countries has

increased almost twofold. However, the consumption of milk has grown more

slowly than that of other livestock products. FAO statistics show that per capita milk consumption is high (> 150 kg/capita/year) in Australia, Europe, Israel, North America and Pakistan; medium (30 to 150 kg/capita/year) in India, Islamic Republic of Iran, Japan, Kenya, Mexico and New Zealand; low (< 30 kg/capita/year) in Viet Nam, most of Central Africa and most of East and Southeast Asia.

After adopting the open economic policies, imported milk products were attracted to consume exceedingly since they had very lower prices. Therefore, the demand for domestic dairy products had fallen and the dairy farmers were discouraged.

Perera & Jayasuriya (2008) reported that studies conducted under Buffalo Development Project showed that the constraints faced by cattle and buffalo farmers in many regions of Sri Lanka were low farm gate price of milk, which is determined by government policy and the monopolistic practices of milk collection systems, shortage of suitable breeding stock in the country and high cost of feeding dairy animals.

Extension services including artificial insemination options and natural services from improved bulls through research centres, skills development of farmers and supply of cattle and buffaloes for breeding

through a network of government livestock farms were adopted as primary strategies for developing the dairy sector from the post-independent times. Since the mid-1990s, several tax concessions, tariff reductions and value-added tax (VAT) exemptions on certain capital goods for dairy products were also made available as further fiscal incentives. Similarly, VAT on locally-manufactured dairy products was removed from 2008 as a further incentive.

Similarly, the newly-introduced credit scheme for milk processing where loans up to 300 million rupees are made available at a concessionary rate of interest has created great interest in the private sector. Many private-sector agencies are planning new investments and this measure is likely to produce new milk marketing opportunities in the country, thereby benefiting the small dairy farmers.

Promoting a liquid milk market is identified as a precondition for increasing the competitiveness of the domestic milk industry in Sri Lanka. Therefore, favourable policy implementation together with incentives would encourage the private sector to improve the export market. Supposing that only the reduction of export subsidies takes place at the import source and Sri Lanka does not agree to reduce its tariff levels for dairy products, world

market dairy prices would increase hence would domestic prices. Under this scenario, domestic producers would be better off and, the consumers would be worse off, and a negative impact on social welfare is unavoidable. (Weerahewa & Rajmohan 2008).

Moreover, prior importance should be given to the feed and feeding materials for dairy cows to obtain satisfactory milk production. The nutritional requirements of dairy cows are met primarily by forages such as grasses, tree fodders, legumes, hay and straw. These are usually supplemented with concentrates enriched with additional energy and protein as well as some minerals. The review of Ranawana (2008) describes that since the quantity and quality of these roughages are variable, the farmers are compelled to use expensive concentrates and make dairying uneconomical.

4. Conclusions and Policy Implications

As per this analysis, it is obvious that the growing demand for milk and milk products offers a good opportunity for producers and other actors in the dairy chain in high-potential, rural areas to enhance their livelihoods through increased production. There is a great potential for producing milk from buffaloes which has not been exploited in Sri Lanka.

Diversification of buffalo milk products would enhance the market value and policymakers in Sri Lanka should introduce a proper marketing channel. It is important to increase the supply of domestic livestock produce at competitive prices for consumers, to achieve sustained and equitable economic and social benefits to livestock farmers. Since the domestic production of milk is sufficient only to meet around 40 % of the national requirement, it is vital to encourage domestic production further, while addressing the remaining bottlenecks in domestic production processes. In addition, small scale milk processing should be encouraged as the output of such producers is important, probably when the price of powdered milk increases in the international market.

Conflicts of interest: The authors have no conflicts of interest regarding this publication

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