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Abstract

Despite being one of the world's top producers and exporters of tea, Sri Lanka's percentage share in the global tea market has been steadily de clining over time. With this background, this study aims to comprehensively examine the growth patterns, instability, and competitiveness, of Sri Lankan tea exports. Secondary data were sole source used in this study. The Compound Annual Growth Rate Analysis and Cuddy Della Valle Instability Index were employed to measure growth rates and instability of Sri Lankan tea exports respectively. Further, a matrix association between growth rate and instability index was employed to classify the major tea importing destinations into four categories. Export competitiveness of Sri Lanka was measured by using Revealed Comparative Advantage Indices. Sri Lankan tea export quantity has shown negative growth, while tea export value has depicted positive growth during the period from 2011 to 2022. Tea exports, irrespective of the process, have shown low instability during the study period. At the same time, Iraq was the most stable market for Sri Lankan tea exports. When compared to other leading exporters Sri Lanka has shown the highest export competitiveness in global tea market in terms of both green tea and black tea exports in packaging not exceeding three kilograms. Kenya shown the highest export competitiveness in black tea exports in packaging exceeding three kilograms followed by Sri Lanka and Rwanda. Vietnam has the highest export competitiveness in green tea exports in packaging exceeding three kilograms among other leading export nations. Further research efforts should be made to analyze the determinants that affect Sri Lankan tea export competitiveness also efforts should be taken for more promotion activities and trade agreements to increase its market share.

Keywords: *Cuddy Della Valle Instability Index, Growth Patterns, Product Mapping, Revealed Comparative Advantage Indices, Tea Exports*

1. Introduction

As one of Sri Lanka's main agricultural exports, tea has played a vital role in the economy as well as the socio-cultural scenario of the country for many centuries. In 2021, tea exports as a percentage of total exports were about 11 per cent while it was 38 per cent of the total agricultural exports in Sri Lanka (Export Development Board (EDB), 2022). Sri Lanka is the fourth leading tea manufacturer and third biggest tea exporter in worldwide (EDB, 2022). Therefore, Sri Lankan tea exports had a tremendous impact on global tea export market as well as the country's economy. Even though the word "Ceylon" has become tantamount of the world's finest tea in over one hundred and fifty years, the percentage share of Sri Lankan tea in the world market has significantly decreased continuously (Kithsiri *et al.,* 2020). Therefore, presently the Sri Lanka experienced the mislaid of its top position in the world tea market and many of its traditional country markets (Hilal, 2020). Hence, the Sri Lankan tea industry should be competitive among the other tea producing and exporting countries and maintain stability in the marketplace to acquire economic benefits to the country.

There is some scientific evidence available in terms of the export trend in the global tea trade (Hilal, 2012). However, there are no recent studies available in this regard and no study has been made on the instability of tea exports over the years. According to Ricardian trade theory, comparative advantage determines the pattern of trade (Ahmad *et al.,* 2021). Balassa (1965) derived an index named Balassa Index, that measures a country's comparative advantage. The Balassa index tries to identify whether a country has a "revealed" comparative advantage rather than to determine the underlying sources of comparative advantage. However, since first suggested, the concept of Revealed Comparative Advantage (RCA) has been a focus of many trade studies and various extensions (Ahmad *et al.,* 2021). Some studies measure RCA at the global level (Vollrath, 1991; Hettiarachchi, 2018; Ahmad *et al.,* 2021), others at a sub-global / regional level and while some others evaluate the measurement as bilateral trade between two countries or trading partners (Dimelis and Gatsios, 1995; Batra and Khan, 2005). To examine the dynamics of comparative advantage of Sri Lankan tea exports in global scenario, the Revealed Comparative Advantage Method was employed. According to existing literature there is no study that can be found on the use of Revealed Comparative Advantage indices especially

Revealed Symmetric Comparative Advantage (RSCA), Trade Balance Index (TBI) and product mapping to assess the export competitiveness of Sri Lankan tea internationally. With this background this study was aimed to examine the historical growth patterns and instances of instability in the domain of Sri Lankan tea exports. Further, the study examined the export competitiveness of Sri Lankan tea among other leading tea exporting nations.

2. Methodology

(a) Data Collection Methods

This study solely depends on secondary data. The overall study period was 2011 to 2022. Tea export data (from 2011 to 2022) collected from the Sri Lanka Tea Board were used. World tea exports and imports in terms of total and country-wise were gathered from the International Trade Centre (ITC) Trade Map. Further, total merchandise exports data for the period of 2011 to 2021 in terms of World and major tea exporting nations were gathered from World Development Indicators (WDI).

(b) Data Analytical Tools

Growth rates of Sri Lankan tea exports were measured by using Compound Annual Growth Rate Analysis while instability was measured by employing Cuddy Della Valle Instability Index. Further, competitiveness in Sri Lankan tea in global tea market was assessed by employing various Revealed Comparative Advantage Indices and product mapping.

(i) Compound Annual Growth Rate Analysis (CAGR)

The growth rates of export indicators for Sri Lankan tea were arrived by using the exponential type of compound growth function as follows (Vilhekar *et al.,* 2022).

$$Y = ab^t e_t \quad (1)$$

Where, Y = Dependent variable for which growth rate is to be estimated (Quantity exported (Mn kg)/ Total real export earnings (Rs. Bn))

a = Intercept
b = Regression Coefficient = (1+g), where g is the compound growth rate
t =Time variable (Years which takes values, 1, 2,n)
e_t = Error term
The logarithmic form of the equation (1) as follows:

$$Log\ Y = \log a + t \log b + \log e_t \quad (2)$$

The compound growth rate (g) in per cent will be calculated by using the following association.

g = (antilog of (log b)-1) x 100 (3)

The significance of the coefficient was tested using the t statistics.

(ii) Instability Analysis

Co-efficient of variation (CV) and Cuddy Della Valle Index (CDVI) (Cuddy and Valle 1978) was used to measure the instability in export indicators of Sri Lanka tea for the period 2011 to 2022.

Co-efficient of Variation (CV)

Co-efficient of Variation which was the simplest measure of instability which can be estimated as follows.

CV = (Standard deviation/Mean) *100 (4)

Cuddy Della Valle Instability Index (CDVI)

In this study, CDVI was employed to assess the instability in Sri Lankan tea exports as well as production indicators. The CDVI is a better index to analyze the instability in agricultural production (Vilhekar *et al.,* 2022) and agricultural exports (Yeligar *et al.,* 2023). Moreover, CDVI adjusts the CV which is overestimated the level of variability in time series data and detrends the series as well as it depicts the direction of the instability exactly.

The Cuddy-Della Valle Index can be expressed as follows;

$$CDVI = CV^{*}\left(\sqrt{1-\bar{R}^{2}}\right) \quad (5)$$

Matrix Association between Growth Rate and Instability

Matrix association between growth rate and instability index was employed to classify the importing countries into four categories (Thaker *et al.,* 2022) as follows.

High Growth and Low Instability (Highly Preferable): A nation whose compound growth rate is greater than the average, but the instability is lower than the average value.

High Growth and High Instability (This category is preferable based on the greatness of growth over instability index): A nation whose compound growth rate and instability are greater than the average.

Low Growth and Low Instability (Less Preferable): A nation whose compound growth rate and instability index values are lesser than the average.

Low Growth and High Instability (Not Preferable): A nation whose compound growth rate is lesser than the average, and whose instability value is greater than the average.

(iii) Export Competitiveness Indices

In this study, various Revealed Comparative Advantage indices were used to assess Sri Lankan tea's export competitiveness. Furthermore, in order to compare Sri Lanka's export performance with that of its rivals, the export competitiveness of other top tea exporters was also computed.

Revealed Comparative Advantage (RCA)

In this study, standard Balassa's Index and its various modified measures were applied to measure the competitiveness of Sri Lankan tea exports in global market. Standard Balassa Index (RCA_{ij}) can be exhibited as follows.

$$RCA_{ij} = (X_{ij}/X_{i})/(X_{wj}/X_{w}) \quad (6)$$

Where, X_{ij} represents the export value of the j^{th} product in the i^{th} country; X_{i}

represents the total merchandise exports of i^{th} country; X_{wj} represents the total export value of the j^{th} product in the world; and X_w represents the total merchandise exports of world. Generally, the RCA > 1 means the country is really taking the advantage of exporting the commodity i.

RCA index ranges of the export competitiveness of agricultural commodities as follows; RCA $\geq$2.500 – Very strong export competitiveness, 1.250 = RCA < 2.500 – Strong export competitiveness, 0.800 = RCA < 1.250 – Medium export competitiveness, and RCA < 0.800 – Weak export competitiveness (Long, 2021).

Revealed Symmetric Comparative Advantage (RSCA)

The Revealed Symmetric Comparative Advantage (RSCA) index was proposed by Dalum *et al.,* (1998) and Widodo (2008). Revealed Symmetric Comparative Advantage (RSCA) index expressed as follows.

$$RSCA = (B-1) / (B+1) \quad (7)$$

Where B is original Balassa's revealed comparative advantage index and values of RSCA range in +1 and -1 with zero as neutral point with respect to comparative advantage.

Trade Balance Index (TBI)

Trade Balance Index (TBI) which was proposed by Lafay (1992) was employed to analyze whether a country is a net exporter or net importer of tea. TBI can be expressed as follows.

$$TBI_{ij} = (X_{ij}-M_{ij})/(X_{ij}+M_{ij}) \quad (8)$$

Where Xij and Mij represent the exports and imports of commodity j by country i. TBI index value ranges from -1 to +1. If TBI equals to the -1, country only imports. If TBI equals to the +1, country only exports. If any value is within the range of -1 to +1, the country exports and imports a commodity simultaneously.

(iv) Product Mapping

Product mapping can be obtained by combining both values of RSCA and TBI Indexes.

RSCA >0	**Group B** Have Comparative Advantage, No Export Specialization (net importer) (RSCA>0 and TBI <0)	**Group A** Have Comparative Advantage, Have Export Specialization (net exporter) (RSCA>0 and TBI>0)
RSCA < 0	**Group D** Have Comparative Disadvantage, No Export Specialization (net importer) (RSCA <0 and TBI<0)	**Group C** Have Comparative Disadvantage, Have Export Specialization (net exporter) (RSCA < 0 and TBI >0)
	TBI < 0	**TBI > 0**

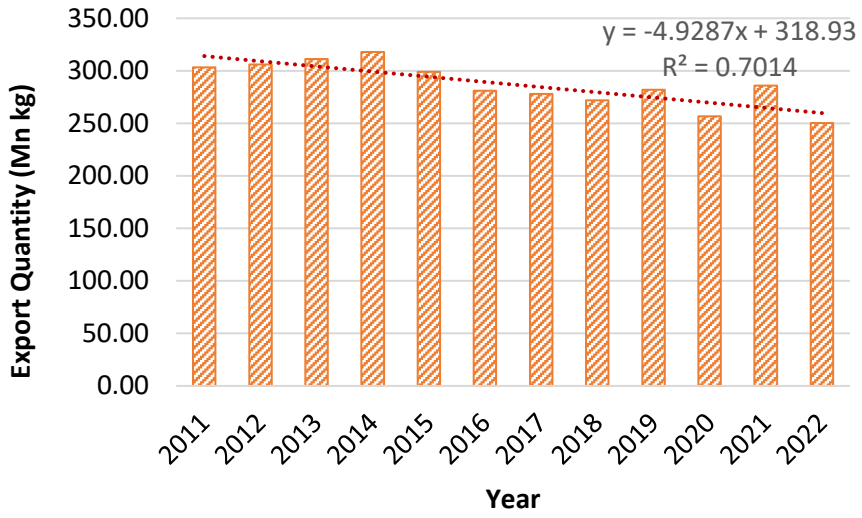
Source: Widodo, 2008

3. Results and Discussion

3.1 Growth Patterns in Sri Lankan Tea Exports

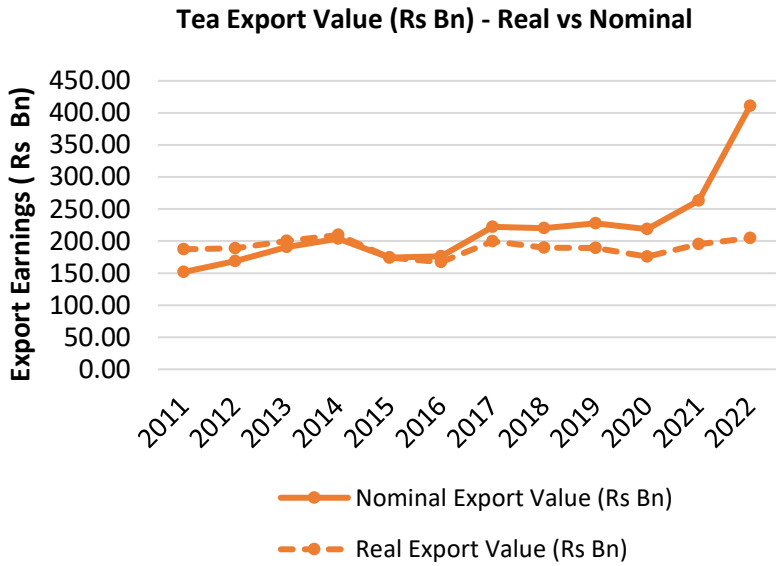
From 2011 to 2022, the tea export quantity shows a downward trend while tea export value has an upward trend. The highest tea export quantity can be seen during 2014 and this may be owing to the crowning tea production quantities in the preceding year (Central Bank of Sri Lanka, 2013).

The lowest tea export quantity can be seen in 2022 throughout the study period owing to the lowest tea production in year 2022(Figure 1). Sri Lanka's lowest tea export quantity in 2022 was primarily due to a fertilizer shortage and the country's economic crisis. However, the highest value in tea export earnings in nominal terms can be seen in 2022 and this may be due to the rupee devaluation during the same year (Figure 2). As depicted in Figure 2, the total tea export earnings in terms of both nominal and real values shows an upward trend throughout the study period (2011-2022).



Source: Authors' Compilation Based on Sri Lanka Tea Board Statistics, 2023

Figure 1: Total Tea Exports Quantity (2011-2022)



Note: For real value - GDP Deflator, base year = 2015

Source: Authors' Compilation Based on Sri Lanka Tea Board Statistics (2023) and World Bank Data, 2023

Figure 2: Total Tea Exports Value (2011-2022)

3.2 Growth Rates and Instability of Sri Lankan Tea Exports

The secondary data on annual tea exports of Sri Lanka with respect to both quantity and value from 2011 to 2022 were used for the compound growth rate and stability analysis.

Table 1: Compound Annual Growth Rates and Instability of Tea Exports from Sri Lanka (2011-2022)

Indicator	Process	Compound Growth Rate (% per annum)	Instability (CDVI)
Export Quantity	Black Tea	-2.11* (0.003)	3.61
	Green Tea	-1.89* (0.005)	6.34
	Instant Tea	5.72* (0.008)	9.47
Export Value	Black Tea	0.55^{NS} (0.005)	6.48
	Green Tea	1.44^{NS} (0.007)	8.86
	Instant Tea	7.63* (0.01)	11.04

Note: Figures in parentheses shown standard errors for their respective coefficients,
*Indicates coefficients are significant at 5 per cent, NS represents not significant
Source: Authors' Work based on SLTB Data, 2023

According to Table 1, Instant tea exports have shown significant and positive growth rates with regard to both volume and earnings. Consequently, black tea and green tea exports have exposed adverse growth rates in terms of quantity while it shown positive growth rates in terms of value. The discrepancy between negative export quantity growth and positive export earnings for Sri Lankan green tea is primarily due to a shift towards higher-value, processed green tea products, rather than simply exporting more raw green tea. Tea exports have shown low instability in terms of both quantity and earnings irrespective of the process type.

Out of different product categories, exports of tea packets (> 3kg) showed the maximum value of growth rates among other categories in terms of both export volume and earnings throughout the study period (2011 -2022). All categories except exports of tea packets (>3kg) and packets (1kg- 3kg) showed negative growth rates in terms of export quantity. Tea in bulk, packets (>3kg), and packets (1kg-3kg) showed positive growth rates in export value. Exports of tea packets (1kg- 3kg) showed high instability in terms of both quantity and value while other categories showed low

instability (Table 2).

Table 2: Compound Growth Rates and Instability of Category-wise Sri Lankan Tea Exports for the Period of 2011-2022

Indicator	Category	Compound Growth Rate (% per annum)	Instability (CDVI)
Export Quantity	Bags	-1.51* (0.006)	6.83
	Bulk	-0.95* (0.001)	1.19
	Packets (>3kg)	5.82* (0.008)	9.38
	Packets (1kg-3kg)	1.86^{NS} (0.035)	36.60
	Packets (3Kg-5kg)	-1.63^{NS} (0.01)	12.67
	Packets (4g-1kg)	-.3.04* (0.004)	4.66
	Packets (5kg-10kg)	-3.23* (0.008)	9.53
Export Earnings	Bags	-0.12^{NS} (0.007)	7.83
	Bulk	0.32^{NS} (0.005)	6.38
	Packets (>3kg)	7.85* (0.01)	11.20
	Packets (1kg-3kg)	1.07^{NS} (0.035)	37.50
	Packets (3kg-5kg)	-0.54^{NS} (0.011)	12.60
	Packets (4g-1kg)	-1.06^{NS} (0.007)	8.45
	Packets (5kg-10kg)	-2.65* (0.008)	9.21

Note: Figures in parentheses shown standard errors, * indicates significance at 5 per cent, NS represents not significant; (0-15 = low instability, 15- 30= medium instability and 30 & above = high instability)

Source: Authors' Work based on Sri Lanka Tea Board Statistics, 2023

3.3 Compound Growth Rates by Import Destination

This section focuses on major importers of Sri Lankan tea exports. During the years 2001 to 2023, these nominated importers were ranked among the top ten. Major importing nations of Sri Lankan Tea were Russia, Iran, Iraq, UAE, Turkey, Azerbaijan, and others (Table 3). All major import destinations and others except Iraq and Turkey indicated negative growth rate in terms of export quantity. Iraq exhibited the highest growth rate of 6.40 per cent and 6.93 per cent in terms of export quantity and values respectively. Russia and Iran shown negative growth rates in tea export earnings. Moreover, total tea exports from Sri Lanka were negatively growing in terms of volume

while positively growing in terms of earnings from 2011 to 2022.

Table 3: Destination-wise Growth Rates for Total Tea Exports from Sri Lanka (2011-2022)

Country	Compound Growth Rate (% Per Annum)	
	Export Quantity	**Export Value**
Russia	-6.66* (0.004)	-5.78* (0.01)
Iran	-10.67* (0.011)	-7.84* (0.01)
Iraq	6.40* (0.007)	6.93* (0.008)
UAE	-1.73^{NS} (0.031)	0.01^{NS} (0.034)
Turkey	5.05* (0.017)	5.71^{NS} (0.026)
Azerbaijan	-0.09^{NS} (0.005)	1.07^{NS} (0.01)
Other	-2.16* (0.004)	0.47^{NS} (0.003)
Total	**-2.05* (0.003)**	**0.11^{NS} (0.006)**

Note: Figures in parentheses shown standard errors for their respective coefficients, *Indicates coefficients are significant at 5 per cent, NS represents not significant

Source: Authors' Calculation Based on Sri Lanka Tea Board Statistics, 2023

3.4 Destination-wise Instability Results

The results of the CDVI with the CV of Sri Lankan tea exports for different export indicators are presented in Table 5. According to CDVI values, other countries showed the lowest instability in quantity (5.28%) and value (6.13%) of tea exports in Sri Lanka. During the study period (2011-2022) all importing destinations exhibited instability in tea exports from Sri Lanka in terms of different export indicators. Of major importing countries Iraq is the most stable market for Sri Lankan tea exports in terms of volume (5.62%) and earnings (9.46%). Further, UAE (32.22%) was the most unsteady market in terms of tea quantity exported from Sri Lanka during 2011 to 2022 while Turkey (30.77%) was the most unsteady market in terms of tea export earnings.

Table 4: Destination-wise Instability Analysis of Sri Lankan Tea Exports (2011-2022)

Destination	Export Quantity		Export Value	
	CV (%)	CDVI (%)	CV (%)	CDVI (%)
Russia	26.02	6.90	25.25	12.62
Iran	34.23	9.63	30.23	14.40
Iraq	23.13	5.62	25.12	9.46
UAE	32.22	32.22	26.29	11.84
Turkey	27.87	14.65	30.77	30.77
Azerbaijan	6.40	6.40	16.42	16.19
Other	9.38	5.28	6.29	6.13
Total	**8.13**	**3.61**	**6.75**	**6.75**

Source: Authors' Calculation Based on Sri Lanka Tea Board Statistics, 2023

The average value of the compound growth rate of export quantity is -1.41 per cent while the growth rate of export earnings is 0.88 per cent. If the compound growth rate is larger than the calculated average value it illustrates high growth and fewer than the average value it exhibits low growth. The average instability index values of export volume and export earnings are 11.53 and 14.49 per cent respectively (Table 5). If the CDVI instability index value is superior than the average value it shows high instability and fewer than the average value it shows low instability.

Table 5: Destination-wise Growth Rate and Instability Index

Country	Compound Growth Rate (% Per Annum)		CDVI (%)	
	Export Volume	Export Earnings	Export Volume	Export Earnings
Russia	-6.66	-5.78	6.90	12.62
Iran	-10.67	-7.84	9.63	14.40
Iraq	6.40	6.93	5.62	9.46
UAE	-1.73	0.01	32.22	11.84
Turkey	5.05	5.71	14.65	30.77
Azerbaijan	-0.09	1.07	6.40	16.19
Other	-2.16	0.47	5.28	6.13
Average	**-1.41**	**0.08**	**11.53**	**14.49**

Source: Authors' Calculation Based on Sri Lanka Tea Board Statistics, 2023

Import destinations for Sri Lankan tea exports were classified into four

categories depend on the results of growth rate analysis and instability index (Thaker *et al.,* 2022).

High growth and low instability (Highly Preferable): Iraq was recorded in this highly desirable category which has high growth rate and low instability in terms of both volume and earnings of Sri Lankan tea exports. Azerbaijan with respect to quantity of tea exports fall under this category while other countries fallen to this category in terms of value of exports.

High growth and high instability (This category is preferable based on the magnitude of growth over instability index): of major importing countries only Turkey in both tea export quantity and earnings, has fallen into this category. Further, Azerbaijan in terms of value of tea exports fall into this category.

Low growth and low instability (Less Preferable): Among major importers, Russia and Iran was reported under this category with respect to tea export quantity and earnings. These countries were less desirable for Sri Lankan tea exports. Other countries were fallen in to this class in terms of the tea exports volume while UAE was fallen to this category in terms of export value.

Low growth rate and high instability (Not Preferable): UAE with respect to quantity of exports fallen to this group. Therefore, different approaches and strategies are required to increase the growth rate and to reduce the instability.

3.5 Export Market Share of Sri Lankan Tea in Global Trade

Export market share of top three leading tea exporters for each Harmonized System (HS) code category of tea exports (HS 0902, HS 090210, HS 090220, HS 090230 and HS 090240) and Sri Lanka were calculated based on the recently available data on ITC Trade Map. The results are depicted in Table 6. In the year 2021, China was the leading tea exporter in the world and it was followed by other major tea exporting nations such as Sri Lanka, Kenya, India, and the United Arab Emirates. Sri Lanka was the market leader of black tea exports, in the packaging category not exceeding three kilograms (HS 090230), in 2021. Further, Sri Lanka ranked in second place in the same

year, in terms of black tea exports, in packaging exceeding three kilograms (HS 090240).

Table 6: World Market Share of Top Three Leading Tea Exporters and Sri Lanka's Position in Global Trade

Commodity	Country 1	Country 2	Country 3	Sri Lankan Rank in Global Trade
Tea (HS 0902)	China (26.65)	Sri Lanka (16.13)	Kenya (13.82)	**2 (16.13)**
Tea, green (HS 090210)	China (56.41)	Japan (7.25)	Germany (4.51)	**5 (3.76)**
Tea, green (HS 090220)	China (68.01)	Vietnam (10.12)	Japan (7.61)	**11 (0.43)**
Tea, black (HS 090230)	Sri Lanka (27.72)	China (11.99)	United Arab Emirates (10.91)	**1 (27.72)**
Tea, black (HS 090240)	Kenya (29.67)	Sri Lanka (18.48)	India (14.50)	**2 (18.48)**

Note: Figures in Parenthesis Indicated Percentage Share of World Export in 2021(in Value term US$)

Source: Authors' Calculation Based on ITC Trade Map Data, 2023

China was the leading export nation of green tea exports in year 2021. Sri Lanka ranked fifth in the same year with green tea exports in packaging not exceeding 3 kilograms (HS 090210) valued at 51,112 US $ Thousand. However, in year 2021 Sri Lanka ranked in 11 in terms of green tea exports in packaging exceeding three kilograms (HS 090220).

3.6 Export Competitiveness of Tea Exports of Sri Lanka

Mean scores of Revealed Comparative Index (RCA), Revealed Symmetric Comparative Index (RSCA) and Trade Balance Index (TBI) for leading tea exporters in the world for aforementioned all HS codes were calculated by using secondary data from 2011 to 2021. In here significant major tea exporters for each HS code category were selected in order to examine the export competitiveness of Sri Lankan tea among other leading tea exporting nations. These selected exporters belonged to top five through the period from 2011 to 2021. Product mapping (Widodo, 2008) were obtained for

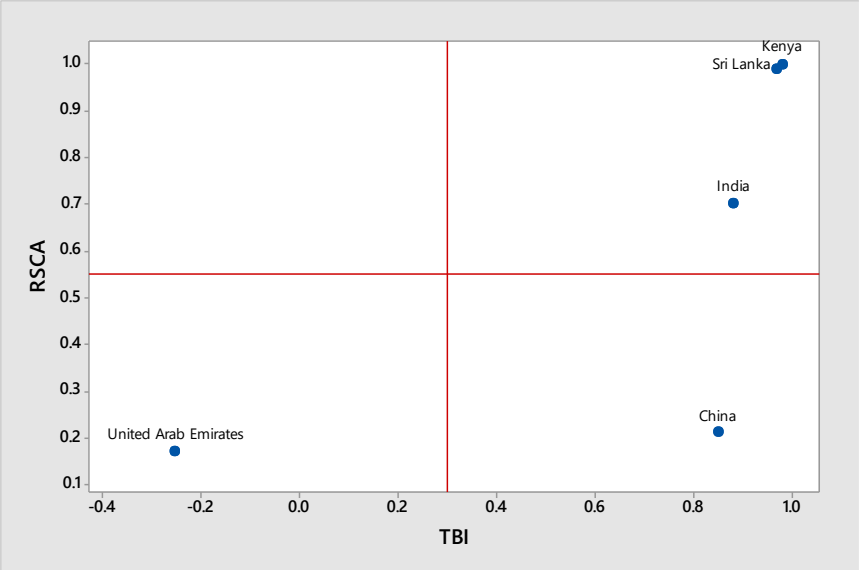
each HS code by combining the both mean values of RSCA and TBI Indices. Mean scores of all indices and product mapping were exhibited as follows.

Table 7: Mean Scores of RCA, RSCA, TBI for Leading Tea Exporters in World: HS 0902 (2011-2021)

Country	Mean Values		
	RCA	RSCA	TBI
China	1.55	0.21	0.85
Sri Lanka	315.59	0.99	0.97
Kenya	489.40	1.00	0.98
India	5.75	0.70	0.88
United Arab Emirates	1.40	0.17	-0.25

Source: Author's Calculation Based on ITC Trade Map Data, (2023) and World Development Indicators, 2023

Table 7 depicts the mean scores of RCA, RSCA and TBI indices for top five tea exporters in the world for 2011-2021. According to the RCA index results all countries have comparative advantage in exporting tea (HS 0902). Kenya (489.40) indicates the highest RCA value for tea exports during 2011 to 2021 while United Arab Emirates (1.40) indicates the lowest RCA for total tea exports. Kenya (1.00) shows the highest RSCA value while United Arab Emirates (0.17) indicate the lowest comparative advantage among them. TBI values show the competition level of tea trade among leading exporting countries during the study period. All countries except United Arab Emirates show positive values while Kenya (0.98) become the first place in tea exporting having highest TBI value. According to TBI values United Arab Emirates shows the very poor export competitiveness among leading tea exporters.



Source: Author's Own Calculation

Figure 3: Product Mapping for Tea Export (HS 0902) Competitiveness

Sri Lanka, Kenya and India have comparative advantage in tea exports (HS 0902) and have export specialization. Therefore, they are net exporters belong to Group A. China have comparative disadvantage and have export specialization. Therefore, net exporter belongs to Group C. United Arab Emirates have comparative disadvantage but no export specialization. Therefore, it can be known as net importer and belongs to Group D.

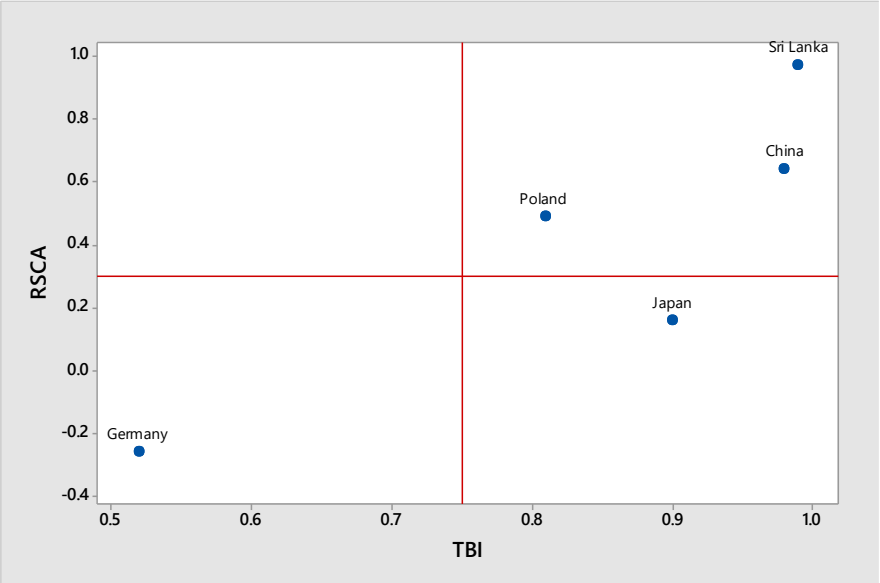
Table 8: Mean Scores of RCA, RSCA, TBI for Leading Tea Exporters in World: HS 090210 (2011-2021)

Country	Mean Values		
	RCA	RSCA	TBI
China	4.51	0.64	0.98
Japan	1.39	0.16	0.90
Germany	0.58	-0.26	0.52
Poland	2.94	0.49	0.81
Sri Lanka	72.01	0.97	0.99

Source: Author's Calculation Based on ITC Trade Map Data, (2023) and World Development Indicators, 2023

Table 8 depicts the mean scores of RCA, RSCA and TBI indices for top five green tea exporters (HS 090210) in the world for the period from 2011 to

2021. According to all indices Sri Lanka shows the highest export competitiveness in green tea exports (RCA=72.01, RSCA=0.97, TBI=0.99) in packaging, not exceeding three kilograms. Germany has comparative disadvantage in according to RCA (0.58) and RCSA (-0.26) indices while it has lowest competitiveness among other leading exporters in terms of TBI (0.52) value.



Source: Author's Own Calculation

Figure 4: Product Mapping for Green Tea Export (HS 090210) Competitiveness

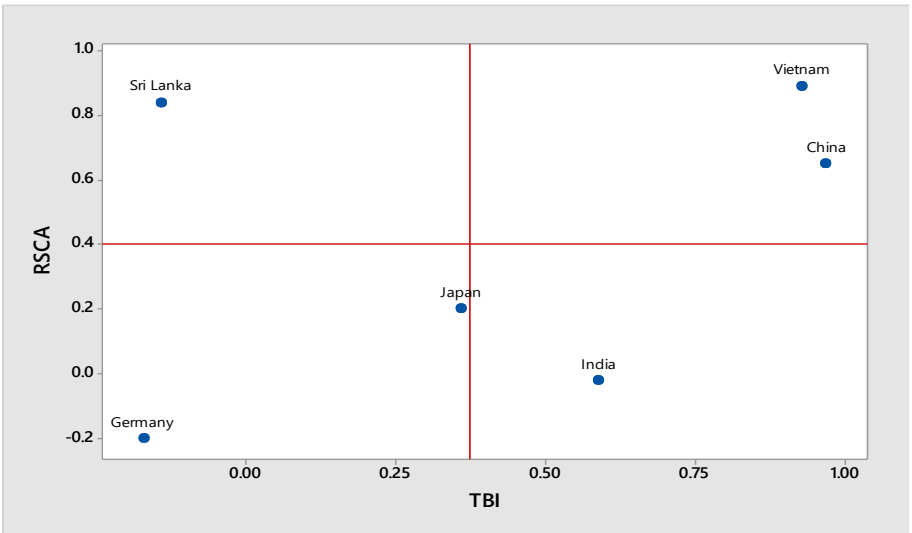
Sri Lanka, China and Poland have comparative advantage in green tea exports (HS 090210) and have export specialization. Therefore, they are net exporters belong to Group A. Japan have comparative disadvantage and have export specialization. Therefore, net exporter belongs to Group C. Germany have comparative disadvantage but no export specialization. Therefore, it can be named as net importer and belongs to Group D.

Table 9: Mean Scores of RCA, RSCA, TBI for Leading Tea Exporters in World: HS 090220 (2011-2021)

Country	Mean Values		
	RCA	RSCA	TBI
China	4.72	0.65	0.97
Vietnam	16.81	0.89	0.93
Japan	1.49	0.20	0.36
Germany	0.67	-0.20	-0.17
India	0.96	-0.02	0.59
Sri Lanka	11.68	0.84	-0.14

Source: Author's Calculation Based on ITC Trade Map Data, (2023) and World Development Indicators, 2023

Table 9 depicts the mean scores of RCA, RSCA and TBI indices for leading green tea exporters (HS 090220) in the world for 2011-2021. Vietnam has the highest export competitiveness in green tea exports in packaging exceeding three kilograms since it shows the highest values in all aforementioned indices. Germany has comparative disadvantage in exporting green tea (HS 090220) as all indices show lowest values. According to RCA and RSCA India has comparative disadvantage while it has export competitiveness according to TBI index value.



Source: Author's Own Calculation

Figure 5: Product Mapping for Green Tea Export (HS 090220) Competitiveness

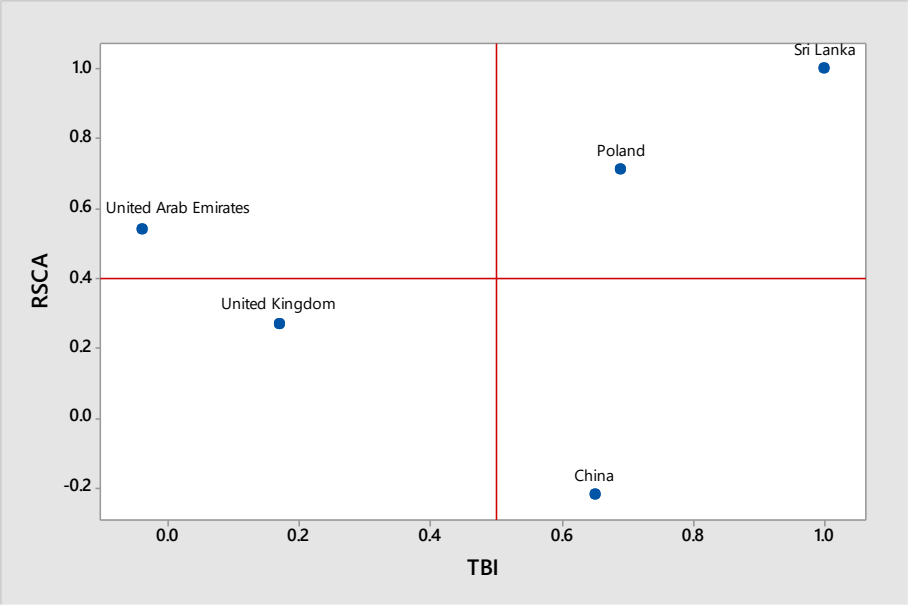
Vietnam and China have comparative advantage in green tea exports (HS 090220) and have export specialization. Therefore, they are net exporters belong to Group A. India have comparative disadvantage and have export specialization. Therefore, net exporter belongs to Group C. Germany and Japan have comparative disadvantage but no export specialization. Therefore, they are net importers belongs to Group D. Sri Lanka have comparative advantage but no export specialization in green tea exports in packaging exceed three kilograms. Therefore, it is a net importer belongs to Group B.

Table 10: Mean Scores of RCA, RSCA, TBI for Leading Tea Exporters in World: HS 090230 (2011-2021)

Country	Mean Values		
	RCA	RSCA	TBI
Sri Lanka	517.22	1.00	1.00
China	0.64	-0.22	0.65
United Arab Emirates	3.36	0.54	-0.04
Poland	5.82	0.71	0.69
United Kingdom	1.74	0.27	0.17

Source: Author's Calculation Based on ITC Trade Map Data, (2023) and World Development Indicators, 2023

Table 10 depicts the mean scores of RCA, RSCA and TBI indices for leading black tea exporters (HS 090230) in the world for 2011-2021. According to the results of aforementioned indices, Sri Lanka has the strongest export competitiveness in black tea exports in packaging not exceeding three kilograms. China has comparative disadvantage in exporting black tea in terms of both RCA (0.64) and RSCA (-0.22) index values. United Arab Emirates has comparative advantage according to both RCA and RSCA indices while it shows poor export competitiveness in terms of negative value of TBI.



Source: Author's own Calculation

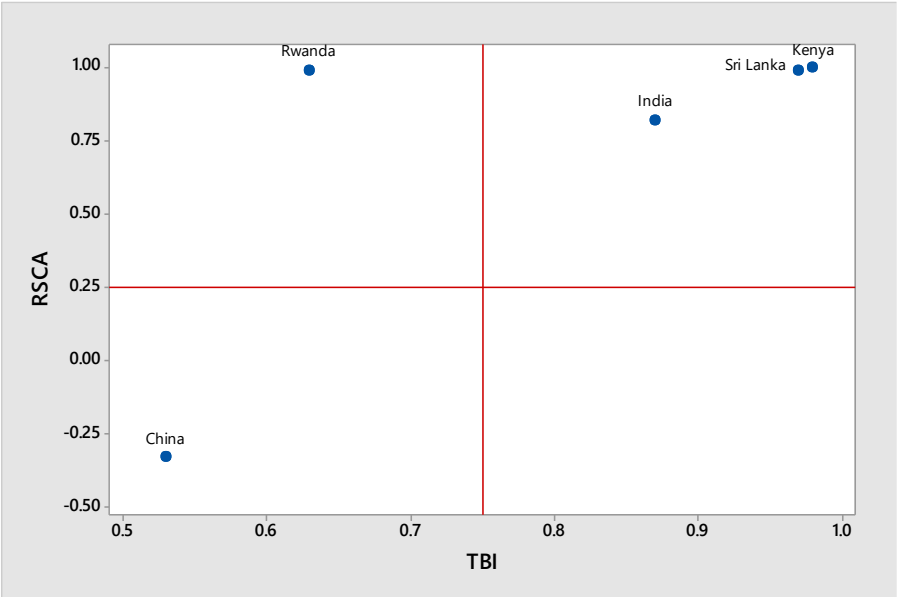
Figure 6: Product Mapping for Green Tea Export (HS 090230) competitiveness

Sri Lanka and Poland have comparative advantage in black tea exports (HS 090230) and have export specialization. Therefore, they are net exporters belong to Group A. China have comparative disadvantage and have export specialization. Therefore, net exporter belongs to Group C. United Kingdom have comparative disadvantage but no export specialization. Therefore, it is net importer belongs to Group D. United Arab Emirates have comparative advantage but no export specialization in black tea exports in packaging not exceeding three kilograms. Therefore, it is a net importer belongs to Group B.

Table 11: Mean Scores of RCA, RSCA, TBI for Leading Tea Exporters in World: HS 090240 (2011-2021)

Country	Mean Values		
	RCA	RSCA	TBI
Kenya	990.94	1.00	0.98
Sri Lanka	338.11	0.99	0.97
India	10.31	0.82	0.87
China	0.51	-0.33	0.53
Rwanda	317.73	0.99	0.63

Source: Author's Calculation Based on ITC Trade Map Data, 2023 and World Development Indicators, 2023



Source: Author's Own Calculation

Figure 7: Product Mapping for Green Tea Export (HS 090240) Competitiveness

Table 11 depicts the mean scores of RCA, RSCA and TBI indices for top five black tea exporters (HS 090240) in the world for the period from 2011 to 2021. According to the results of all indices, Kenya shows the highest export competitiveness in black tea exports in packaging exceeding three kilograms followed by Sri Lanka and Rwanda. China has comparative disadvantage in black tea exports (HS 090240) according to RCA (0.51) and RSCA (-0.33) values.

Kenya, Sri Lanka and India have comparative advantage in black tea exports (HS 090240) and have export specialization. Therefore, they are net exporters belong to Group A. China have comparative disadvantage but no export specialization. Therefore, net importer belongs to Group D. Rwanda have comparative advantage but no export specialization in black tea exports in packaging exceeding three kilograms. Therefore, it is a net importer belongs to Group B.

4.0 Conclusion and Recommandations

The study's conclusions indicate that although tea exports had negative growth between 2011 and 2022, tea export value has shown positive growth. The highest tea export quantity was recorded in 2014; this may have been caused by the previous year's highest tea production as well as initiatives such the Sri Lanka Tea Board's extension and subsidy programs. The lowest tea production in 2022 as a result of the scarcity of fertilizers and agrochemicals led to the lowest amount of tea exported. The Sri Lankan rupee's (LKR) depreciation and the year 2022's strong demand, however, may have contributed to the highest value in export earnings that year.

Tea exports, irrespective of the process, have shown low instability throughout the study period. When considering category-wise tea exports, exports of tea packets (> 3 kg) showed the highest growth rate throughout the period, with effect from January 2011 to December 2022, while exports of tea packets (1 kg–3 kg) showed the highest instability. Further, there is a high interest in value-added tea products in the modern world. Therefore, there should be more value addition research and development initiatives carried out.

According to the major import destination-wise results, Iraq has shown the highest positive growth rates in tea export volume and earnings. Further, it was revealed that Iraq was the most stable market for Sri Lankan tea exports because it had a high compound annual growth rate and low instability throughout the study duration (2011-2022). Moreover, Iraq has fallen into the top ten importing countries of Sri Lankan tea for more than two decades. According to the recent statistics obtained from the Sri Lanka Tea Exporters Association, Iraq has remained in the highest position for the period with effect from January 2023 to June 2023.

As a leading tea producer and exporter, Sri Lanka should apply suitable export promotion strategies to evolve in existing stable markets and find potential markets for Ceylon tea. For example, by having bilateral trade agreements and introducing trade representatives, Sri Lanka can increase its market share in export destinations.

The findings of the RCA, RSCA and TBI indexes are closely compatible with each other throughout the study period. When compared other leading exporters Sri Lanka shows the highest export competitiveness in global tea market in terms of both green tea and black tea exports in packaging not exceeding three kilograms. Kenya shows the highest export competitiveness in black tea exports in packaging exceeding three kilograms followed by Sri Lanka and Rwanda. Vietnam has the highest export competitiveness in green tea exports in packaging exceeding three kilograms among other leading export nations. Moreover, further research efforts are recommended for analysing the determinants that affect the Sri Lankan tea export competitiveness.

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An Assessment of Financial Literacy of Farmers in the Domestic Agricultural Sector in Sri Lanka

P.C.J. De Silva

Abstract

Poor financial literacy is a major contributor to economic and social challenges in Sri Lanka's rural agricultural sector. This study assessed financial literacy levels among farmers in Ampara, Anuradhapura and Kurunegala districts, focusing on influencing factors, household expenditure patterns and credit needs. A descriptive quantitative design was used, with primary data collected through a survey of 300 farmer-households randomly selected from 12 farmer organizations. Data analysis employed descriptive and inferential statistical techniques, including multiple regression, t-tests, one-way ANOVA and correlation analysis. Financial literacy was measured based on three components—financial knowledge, behaviour and attitude—using 10-point Likert scale indicators.

The study found an overall financial literacy level of 52.5%. Component-wise scores were 45% for knowledge, 44% for behaviour and 68% for attitude. Male and female literacy levels were similar at 53% and 52%, respectively, with no statistically significant difference. Income and education positively influenced financial literacy, while age and sex showed negative correlations. Most households lacked formal budgets or financial plans but demonstrated disciplined spending within income limits. Food expenditure accounted for around 40% of monthly income, while investment and alternative income-generating activities were minimal due to risk aversion and lack of skills. Credit needs were met mainly through formal sources, with no defaults reported. However, usage of financial products and services remained low, reflecting gaps in financial knowledge. The findings suggest that improving education and income levels can significantly enhance financial literacy, warranting targeted policy interventions to strengthen financial capabilities among rural farmers.

Key words: *Financial Literacy, Financial Knowledge, Financial Attitude, Financial Behaviour, Domestic Agriculture, Financial Inclusion*

1. Introduction

Financial literacy is a key factor in ensuring the wellbeing of poor and marginalized people in developing countries. According to Rai (2019), achieving financial prosperity requires a sufficient level of financial literacy. Invariably, poor financial management can influence a person's behaviour, making them more vulnerable to a financial crisis. Financial literacy is a combination of awareness, knowledge, skills, attitude and behaviour necessary to make sound financial decisions and ultimately achieve individual financial wellbeing (OECD, 2021). Akande (2023) states that poor financial literacy and financial exclusion have perennially conditioned the poor to a life of perpetual poverty. According to Sandra and Carolyn (2002), financial literacy is essential for being aware and minimizes the likelihood of being misled in investment decisions. Poor financial literacy leads to financial exclusion, a situation in which individuals lack access to mainstream financial products and services, including bank accounts, credit cards, insurance policies, and loans from formal financial institutions (Alanso, 2020). Accordingly, poor financial literacy is a definite threat to the financial and economic wellbeing of individual households as well as communities at large.

In Sri Lanka, despite a higher standard of print literacy, financial literacy is deemed comparatively low, standing at 57.9% in 2021 (Central Bank of Sri Lanka, 2021). Additionally, certain pockets, especially in the rural agricultural sector, have been identified with even lower levels of financial literacy. It is evident that in the rural agricultural sector, issues directly related to and attributable to poor financial literacy prevail.

In Sri Lanka, though the agricultural sector's contribution to the country's GDP, as to the figures from the Department of Census and Statistics (DCS) is just 6.9% in 2021 (https://www.cbsl.gov.lk/), over 80% of the population still lives in rural areas (https://data.worldbank.org/indicator) and a considerable percentage directly and indirectly depends on agriculture. Additionally, poverty rates in the country are higher in agricultural districts than the national average. According to the DCS statistics, over 82% of the poor are located in the rural sector, indicating that poverty in the country is more prevalent in rural areas (www.statistics.gov.lk). Studies show various

reasons that account for the high rural poverty, and most of these reasons are clearly related to and reflect poor financial literacy.

According to Gamage (2012), low household income, lack of alternative livelihoods or sources of income, household debt, unnecessary borrowings, and borrowing from informal lenders, high production costs, neglect of market information and proper extension support, and absence of production plans are the major attributions of the rural agricultural sector. These are effects or the consequences of poor financial literacy (Patel, 2023).

Damayanthi (2013) identifies that low income from agriculture has caused the farmer community, especially the youth, to lose interest in agriculture and resort to alternative livelihoods, such as driving three-wheelers, working as helpers in construction sites, or being employed as security guards. However, the trend of shifting to alternative sources of income, including female household members migrating overseas, has not significantly contributed to increasing household income, financial stability, or wellbeing among the farming community (De Silva, 2015). Paradoxically, it has led to abandoning agricultural lands which consequently affects the national food production.

Besides, some serious socio-economic issues rampant in rural agricultural areas in Sri Lanka clearly reflect the consequences of poor financial literacy of rural agricultural communities. To mention a few, these are higher rates of suicides, domestic violence, poor education, higher dropout rates, high malnutrition, migration of unskilled young mothers as housemates to Middle East countries, causing severe social issues. These problems are undoubtedly due to poverty, a condition that can be directly attributed to poor financial literacy. Therefore, it is highly important and a prior requirement to look into the level of financial literacy, which consists of financial knowledge, attitude and behaviour of the domestic agricultural households and make aware the policy makers of the initiatives should be taken to improve these aspects because that would benefit the farmer communities as well as the whole country.

1.1 Research Problem

As discussed above, literature on the domestic agricultural sector reveals that farmer households suffer from numerous issues, and these issues have a clear relevance to poor financial literacy. Therefore, it is timely to identify issues and make suggestions to improve the level of financial literacy of rural farmer communities. Accordingly, this study aimed to assess the level of financial literacy among rural agricultural populations and explore ways to improve it.

1.2 Research Objectives

The primary objective of the study was to evaluate the financial literacy of farmers in the domestic agricultural sector of Sri Lanka. Specifically, it aimed to:

1. Identify the factors affecting the financial literacy of the farmers in the domestic agricultural sector;
2. Discuss the distribution of household expenditure;
3. Examine the sources of credits and the credits needed by the agricultural households; and
4. Recommend suggestions to improve the level of financial literacy of farmers in the domestic agricultural sector.

1.3 Research Hypothesis

The **s**tudy was guided by the following hypotheses:

H_1: There is a significant relationship between the financial attitude and financial behaviour.

H_2: There is a significant relationship between education and financial literacy.

H_3: There is a significant relationship between monthly household cost and financial literacy.

H_4: There is a significant influence of gender on financial literacy.

1.4 Literature Review

Although financial literacy has emerged as a relatively recent consideration in determining financial and economic wellbeing, particularly among rural agricultural and marginalized communities, a substantial body of literature has been developed around this concept. Financial exclusion can lead to debt, being cut off from essential utilities, and result in feelings of financial insecurity. According to Patel (2023), in layman's terms, financial literacy refers to literacy about finance. Additionally, he states that if anyone possesses the knowledge or skill to manage finances, they are financially literate. Financial literacy, or the financial knowledge includes awareness and knowledge to decide on savings, borrowings, and some planning for future income. Just as Alando (2023) mentioned above, Patel also opines that financial literacy drives the process of financial inclusion, which ensures the ease of access, availability, and usage of financial services by underprivileged and disadvantaged sections of society at an affordable cost. He also further says that financial literacy is having a basic functional understanding of money and how to manage it.

As to Remund (2010) as refereed by Safitri (2021), financial literacy is a measurement of a person's understanding of financial concepts, and the ability and confidence to manage personal finances through making appropriate short-term decisions, long-term financial planning, and paying attention to economic events and conditions while Huston (2010) says that financial literacy includes awareness and knowledge of financial instruments and their applications in business and life.

In Sri Lanka, although no studies were found specifically focused on domestic agricultural communities, there are studies conducted that look into the financial literacy of different targeted segments of society.

Kumari (2020) conducted a study which covered all 25 districts of the country and consisted of a 450-respondent sample. The study, whose main argument is whether financial literacy is a significant determinant of financial inclusion in the Sri Lankan context, finds that financial literacy has a positive and significant impact on financial inclusion in rural communities in Sri Lanka. However, when considered under separate dimensions, the study also finds that financial knowledge and financial attitudes have the

most significant impact on financial literacy among rural communities. Based on the findings, the study concludes that financial literacy can be considered a significant determinant of the financial inclusion of rural communities in the Sri Lankan context as well. Accordingly, the researchers offer some suggestions for government policymakers to overcome financial exclusion and ensure the financial inclusion of rural communities in Sri Lanka.

Madushani (2023) examined the financial literacy level of professionals working in various professions, including Medicine (Doctors), Engineering (Engineers), Management (Managers), Law (Lawyers), and Aviation and Navigation (Captains and Pilots), as well as its determinants. The study, based on a quantitative survey approach involving a sample of 300 respondents from the Colombo district, has revealed that the basic and advanced financial literacy among professionals is at a medium level. However, the level of financial literacy was not satisfactory among non-management professionals, particularly doctors and lawyers. The regression analysis reveals that economic and financial education, self-analytical skills, field of employment, and monthly income level are all influential determinants of financial literacy as independent variables. Accordingly, the study emphasizes the importance of implementing a national strategy to improve financial and economic educational programs, particularly for individuals who are not working in the professions related to management.

Balagobei (2023) conducted a study aimed at investigating the influence of financial literacy on investment decisions of individual investors in the Jaffna district. The study examines the influence of financial knowledge, financial behaviour, and financial attitude on investment decisions among 200 individual investors randomly selected from across the entire district, based on primary data collected through a structured questionnaire. Accordingly, the findings revealed that financial literacy has a positive influence on investment decisions of individual investors. Therefore, the study recommends the necessity for effective financial literacy programs focusing especially on enhancing financial knowledge, behaviours and attitudes to facilitate informed investment decisions of individual investors.

2. Methodology

2.1 Research Design

The study employed a descriptive quantitative design, which allows for the use of both descriptive and quantitative data analysis (Kraemer, 1991). This research design is more appropriate for the problem addressed in this study.

2.2 Data Collection

The data consisted of both primary and secondary sources. Primary data collection was done on a sample of 300 farmers from the three study districts Ampara, Anuradhapura and Kurunegala. These three districts were selected based on the extent of land cultivated and food crop production (Central Bank, 2022). Farmer-participants were selected equally from 12 Farmer Organizations (FOs) in 6 Agrarian Development Center (ADC) areas, selected two each from a district. Besides the sample survey, two Focus Groups Discussions (FGDs) and Key Informant Interviews (KIIs) were also used as primary data collection techniques. KIIs were held with two Agrarian Development Officers in the sample ADCs and the two Agricultural Instructors attached to the divisions. In addition, the office bearers, chairman and secretary of each farmer organization from which the sample was selected were also interviewed as key informants with semi structured questionnaires. The primary data collection instrument was a structured questionnaire administered to 300 sample farmers. The questionnaire was pilot-tested with 15 farmer households in a similar setting to the sample areas.

2.3 Data Analysis

Data were analyzed using both descriptive and inferential statistical techniques. The technique of multiple regression analysis was used to identify the factors affecting financial literacy.

$$FLi = \beta o + \beta 1age + \beta 2education + \beta 3income + \beta 4gender + \beta 5no.of\ trainings\ received + ei`$$

FLi = financial literacy

Bo = constant

β1 – β5 = are regression coefficients that are determinants of change to FLi

ei = error term

FLi is the level of financial literacy of farmers 1, 2, 3, ... n; $\beta 0$, $\beta 1$, $\beta 2$, $\beta 3$, .., are the parameters to be estimated. The level of financial literacy of farmers will be measured by an index built from the answers to a series of questions related to the financial literacy components mentioned above.

The financial literacy index was calculated using the following formula (Yarasevika, 2016 and Safitri 2021):

$$Farmer's\ financial\ literacy = \frac{index1 + index2 + index3}{3}$$

Index 1 represents farmers' financial knowledge; index 2 represents farmers' financial behaviour; index 3 represents farmers' financial attitude, and these three indexes together will determine, as obvious in the above formula, the farmers' financial literacy.

The construction of each index is based on 10 items that explain the concerned aspects of financial literacy, and the respondents' answers to each item were measured on a 5-point Likert scale. Likert scales take values from 1 to 5, respectively, corresponding to the 5 points from "Strongly disagree" to "Strongly Agree" with "Neutral" in the middle. Value for each index of a respondent will be decided by dividing his or her total score for all 10 statements by the maximum score possible for the same.

2.4 Ethical Considerations

This study is government treasury-funded research. As a result, the study underwent a thorough process before getting approval. All authorities from top to bottom including the Department of Agrarian Development and the Department of Agriculture both at the national level and divisional level were informed and made aware of the study. The selection of the sample occurred specially according to the information obtained and with the cooperation of both departments. A collection of survey data at the grassroots level from the farmer-respondents was planned, ensuring the

maximum convenience of the respondents and informing them of the survey purpose, thereby obtaining their informed consent. During the interview, the respondents had the choice to answer the questions at their own will. The questionnaire preparation was done with maximum care and prior testing was made to avoid confusion, and possible embarrassment to respondents other than ensuring only the most required information was collected. Also, the survey which had no physical or psychological harmful effect, was carried out by a team of prior trained enumerators.

3. Findings of the Study

The study sample consisted of 210 males and 90 females. The majority of the sample (65%) had received education from grade 6 to grade 11, while as many as 14% had been schooled for less than grade 5. The average financial literacy level of the total sample of 300 participants was 52%. The average scores of the three components, namely, financial knowledge, financial attitude, and financial behaviour, for the total sample respondents were 45%, 68%, and 44%, respectively. A statistically significant relationship between financial attitude and financial behaviour was found with a probability (p) value of .000. So was the level of education to financial literacy with the same p value. Financial literacy had a significant positive relationship with the respondent's income, with a p-value of 0.000.

Table 1: Financial literacy scores of male and female respondents

Sex	Financial Knowledge	Financial Attitude	Financial Behavior	Financial Literacy
Male	0.45	0.68	0.44	0.53
Female	0.45	0.68	0.43	0.52

Source: Jayampathi, et al. 2025

Table 1 shows the average financial literacy levels for males and females, which were 53% and 52%, respectively. Also, the average scores of the components that comprise financial literacy, such as financial knowledge, financial attitude, and financial behaviour, are the same, except for a slight difference in financial behaviour. Similarly, it was found that the slight difference in mean financial literacy of male and female respondents was also not statistically significant.

Table 2 shows the information on the financial literacy of the respondents in four age categories. As shown, the younger participants have higher scores in all aspects of financial literacy.

Further findings of the study reveal that the majority (over 95%) do not have budgets that plan their finances, such as spending, savings, or investments. Also, 90% of the participants do not keep records of their expenses or prioritize their needs when spending their income. Besides, the majority was also found to be risk-averse, worried over the uncertainty prevailing, as their only income from agriculture is susceptible to threats from wild elephants and other means of crop failures, including floods and droughts.

Table 2: Age and financial literacy

Age (years)	No. of Respondents	Financial Knowledge	Financial Attitude	Financial Behavior	Financial Literacy
20-40	46	0.48	0.71	0.47	0.55
41-59	182	0.46	0.68	0.45	0.53
60-70	69	0.41	0.66	0.39	0.49
>70	03	0.34	0.66	0.40	0.47
All	**300**	**0.45**	**0.68**	**0.44**	**0.52**

Source: Jayampathi, et al. 2025

The multiple regression teste conducted on the factors such as level of education, gender, total monthly income and age study found to have a statistically significant relation to the financial literacy of the sample with a p-value of 0.000. The respective R value which is 0.452 indicates that chosen factors, or independent variables, can explain or otherwise are responsible for nearly half of the financial literacy of the studied population, or 45%. In considering the monthly household expenditure of the study sample, it was found that the total average monthly household cost for the entire sample of respondents was Rs. 65,578, and the average cost of food consumption alone was Rs. 25,033, which accounts for 38% of the total monthly household cost. This amount does not include the cost of rice, other cereals, and vegetables, as the majority of households produce their own. However, there was no significant difference in monthly household cost between and among the sample respondents of the three study districts. The second highest cost for households was the education of children, at 13%, while 12% was incurred on fuel and only 9% on loan repayment. In considering

household expenditure, it was found that the sample households were concerned about their expenses and tried their best to keep them within their income limits, although they did not have plans or budgets in the majority of cases to control their expenses. Also, the non-extravagant, simple lifestyle and limited needs seem to have helped more than financial literacy in the sample people to live a debt-free, contented life.

It was found that, among the entire sample of 300 respondents from the three districts, only 160 (52.6%) had obtained loans from any source. The participants had approached government banks, Samurdhi Bank, Govijana Bank, village death donation societies, leasing companies, and relatives or friends for their credit requirements. It was also found that respondents do not borrow from informal money lenders.

As many as 83 (27%) of the entire sample, which is more than 50% of those who obtained loans, have obtained their loans from government banks. While the next highest, at 22% of respondents from the entire sample, or 13.75% of those who obtained loans, have received their loans from the Samurdhi Bank. Most of those who had not obtained loans were found to have pawned their jewellery when they needed money. However, in paddy cultivation, the majority was found to have borrowed inputs from input traders on the promise of selling paddy to them to compensate for their borrowing of inputs. Nevertheless, this practice was revealed not favoring the farmers as the trader charges higher prices for the inputs and the farmer necessarily has to sell his/her produce to the same trader, often at a loss.
No cases of loan default were reported from the sample. However, it was found that the majority of those who had not obtained loans from any source are generally averse to loans. Similarly, the majority (82%) was found not to have made any investment either in agriculture or any other sector. In general, the respondents had limited knowledge regarding investment. Saving is the only option they were familiar with.

It was found that the majority (83%) of the sample had ATM cards, but the use of other financial products was minimal. Also, the use of credit cards and online banking facilities was found to be as low as 3% and 2%, respectively. However, the entire sample had bank accounts, while 21% used them only to receive the fertilizer subsidy. From the entire sample, only 2% had an insurance policy. While the majority (90%) had no specific

retirement plan. Similarly, as many as 63% of respondents were satisfied with their financial and economic situation and were not inclined to earn a higher income or take risks, but were content to spend their lives easily with some means of livelihood that ensured their existence.

Study findings reveal that only a few (3%) make any efforts to utilize modern technology to increase production, while the majority follow the same procedure without any such interest or initiative. Besides, in contrast to the expectation or assumption that higher financial literacy negatively correlates with the cost of production, it is the other way around, as indicated by the study's findings. Accordingly, there was a statistically significant positive correlation, respectively, with p values of 0.012 and 0.021, between the level of financial literacy and the cost of production of both paddy and Other Field Crops (OFC).

4. Conclusion

The study was conducted in three main agricultural districts, with a sample of 300 farmer households, mainly focused on assessing the financial literacy of farmers in the domestic agricultural sector. The financial literacy level was assessed using weighted average scores of three main components: financial knowledge, financial behaviour, and financial literacy, measured using a total of 30 Likert scale indicators. Accordingly, it was found that the overall mean financial literacy of the respondents was comparatively at a lower level, with no significant difference between the figures for males and females. Basically, respondents lack financial knowledge and behaviour, although they have a comparatively better financial attitude. It was also found to have a statistically significant relationship between financial attitude and financial behaviour, while the level of education had a similar relationship to financial literacy. Similarly, financial literacy had a statistically significant positive relationship with respondents' income. There was no significant relationship between the gender of the sample respondents and their financial literacy.

The respondents' remarkably low use of financial products and services reflects their poor financial knowledge. Although almost all respondents had bank accounts, only about one-quarter of them used them to receive cash for fertilizer subsidies. While the majority had a savings account, not a

single respondent had a current account. The majority of those who have ATM cards were unable to use them by themselves. Additionally, a few from the entire sample had an insurance policy, credit cards, and the ability to use online banking, while those with a retirement plan were very few. Again, only a few respondents had any investment ideas or had made any investments in fields other than agriculture. The majority preferred to save money if they had any excess, rather than making any investment, either in agriculture. Additionally, it was found that the majority were content with their living standard and what they had, and lacked motivation or the will to take on any challenges or risks.

Accordingly, as evident from the study's findings, it is necessary to enhance the financial knowledge of rural agricultural people, equip them with the necessary skills and knowledge, and improve their talents to broaden their sources of income. That would ensure they have more investment opportunities and the will to take risks and become more involved. That will ultimately help increase financial literacy and financial inclusion, which will contribute significantly to the development of rural farming communities and, in turn, to the entire nation.

5. Recommendations

Financial literacy was found to have a statistically significant positive relationship with education. As a result, it is required to make measures to provide financial literacy through formal school education. Additionally, as the impact of income on financial literacy is comparable to that of education, measures are necessary to increase the income of agricultural communities in order to enhance their financial literacy. In particular, it is required to develop entrepreneurial skills, provide awareness of investment opportunities, and improve knowledge, skills, and talents required for creating alternative livelihoods while encouraging and facilitating the increase in efficiency and productivity of agriculture using appropriate technology. Subsidising the cost of agricultural equipment is also recommended, as it is necessary to encourage farmers to adopt and implement modern technology on their farms. This will undoubtedly be a boost to attract young people to agriculture and yield higher profits.

Concerning the power and responsibility vested in FOs, they can contribute significantly to increasing the income of farmer-households, reducing costs, providing credits, and creating alternative sources of income and investment opportunities. These potentials in FOs are a definite boost to improving the financial literacy and financial inclusion of rural agricultural people, thereby enhancing the development of agricultural communities. Furthermore, regular farmer awareness and training programs are needed to provide them with new skills and knowledge on various aspects, such as cost-effective farming methods, alternative livelihood opportunities, investment opportunities, and climate-resilient methods, among others. Additionally, programs should be implemented to change attitudes and foster confidence and self-reliance. Such skills and attitudes will help farmers face challenges, take risks, and be more economically active and productive. The Department of Agriculture and the Department of Agrarian Development can conduct such programs, specifically targeting young farmers at the divisional level regularly.

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Dairy Sector Transformation under the 2006 Policy Framework: Progress and Challenges

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Abstract

The dairy sector in Sri Lanka plays a crucial role in rural livelihoods, food security, and economic stability. However, heavy reliance on milk powder imports and stagnant domestic production have highlighted the need for policy-driven reform. This article evaluates the 2006 National Dairy Policy, which aimed to increase domestic milk production and achieve 50% self-sufficiency by 2015 through strategies such as genetic improvement, commercialization of dairy farms, and institutional support. Using a mixed-methods approach, the study examines the relevance, effectiveness, and efficiency of dairy development programs and projects implemented over the past 15 years. Data were gathered from secondary sources and interviews with key stakeholders. The findings reveal that while several projects such as the Dairy Village and breeder farm initiatives contributed to localized production increases, systemic challenges persist. These include limited access to quality breeding material, inadequate veterinary services, poor feeding practices, and a lack of youth engagement. The study also identifies policy implementation gaps, weak institutional coordination, and insufficient private sector participation. Recommendations include enhancing artificial insemination services, promoting modern dairy technologies, expanding public-private partnerships, and strengthening farmer training and market linkages. Although the 2006 policy laid a foundation for sectoral growth, its impact has been uneven, necessitating renewed and adaptive policy

Key Words: *Dairy Policy Evaluation, Milk Self-Sufficiency, Livestock Development, Dairy farming, Sri Lanka*

1. Introduction

The dairy sector in Sri Lanka plays a vital role in the rural economy by generating income and employment opportunities. Milk production is also essential for addressing nutritional poverty, as it provides high-quality protein and other vital nutrients (FAO, 2020). However, the country's heavy reliance on imported milk powder continues to strain the national economy, highlighting the urgent need to strengthen domestic milk production (DAPH, 2019). Revitalizing the dairy industry offers multiple benefits, including enhanced food security, reduced rural poverty, and lower import expenditure (Perera, et al., 2008).

Despite these potential benefits, several constraints hinder progress. Farmers face challenges such as limited access to credit, the unavailability of quality breeding stock, and inadequate advisory and veterinary services. A value chain analysis conducted in the Killinochchi District by Achchuthan and Kajanathan (2012) revealed that most dairy farmers operate on a small scale, and scaling up production could significantly improve their income levels. Access to modern technology and updated technical knowledge is also critical for enhancing productivity. Therefore, strong collaboration between the government and the private sector is essential to ensure the sustainable development of the dairy industry (Perera and Jayasuriya, 2008). Policy instruments play a key role in influencing economic agents and achieving strategic goals in the dairy sector. Various policies and programs have been introduced to promote milk production and ensure stable, high incomes for dairy farmers (Morgan, 2009). However, the 2006 National Dairy Policy target of achieving 50% self-sufficiency in milk production by 2015 was not fully realized. Evaluating these policy initiatives is essential to identify existing gaps and recommend necessary adjustments. Although some progress has been made, further efforts are required to enhance milk production and reduce dependence on imports, thereby strengthening economic stability and food security.

Over the years, Sri Lanka has implemented a series of dairy development policies aimed at achieving self-sufficiency and modernizing the industry. These policies have emphasized input provision, market infrastructure, value addition, consumer protection, and import regulation. Nevertheless,

despite favorable policy frameworks, the number of dairy farmers has been declining due to market vulnerabilities and weak institutional integration (FAO, 2017). Supporting farmers through income-generating opportunities and improved distribution systems remains crucial for long-term resilience. Notably, projects such as the Dairy Village Development Project have demonstrated localized success, with milk production increasing by approximately 30% (Hitihamu, et al., 2008).

Persistent challenges such as high input costs, technical limitations, and low youth engagement continue to constrain the sector. Although Sri Lanka's dairy sector development has been guided by the 2006 policy framework, the overall progress remains below expectations. Therefore, a comprehensive policy evaluation is necessary to assess the sustainability, effectiveness, and efficiency of implemented programs. Strengthening the dairy sector further contributes to employment generation, economic stability, and the alleviation of nutritional poverty. Moving forward, greater emphasis should be placed on promoting commercial dairy entrepreneurship, improving institutional coordination, and introducing innovative milk marketing strategies to ensure sustainable growth.

The primary objective of this article is to evaluate the impact of the 2006 National Dairy Policy by examining the appropriateness, effectiveness, and efficiency of dairy development programs and projects implemented in Sri Lanka over the past 15 years, and to propose strategies for improving policy implementation and sectoral performance.

2. Methodology

This study used a mixed methods approach, which involves the systematic integration of both quantitative and qualitative data. Data collection involved a comprehensive literature review, survey, focus group discussions, and reviews of relevant reports. In addition, secondary data was collected from various databases, including those from the Department of Census and Statistics, Central Bank, Department of Animal Production and Health, Ministry of Livestock Development, and other published and unpublished data sources from 2007 to 2021.

2.1 Conceptual Framework

Policy evaluation is a process that assesses a policy's value, considering the specific context, political, and economic factors. This study focused on implemented dairy development policies, identifying goals, objectives, and strategies used. Projects like Dairy Village, Breeder Farm, Liquid Milk Promotion, and Buffalo Farm were primarily implemented by the Ministry of Livestock Development to achieve policy objectives. The evaluation framework examined inputs, outputs, efficiency, and effectiveness. Relevance, coherence, and opposing policies were considered, along with the policy's sustainability through social, economic, and environmental impacts. This study employed a comprehensive framework to evaluate the dairy development policy, encompassing relevance, effectiveness, efficiency, coherence, and sustainability to understand its outcomes and impact on the dairy sector.

2.2 Research Methods

This assessment is to evaluate the relevance, effectiveness, and efficiency of the dairy development programs and projects implemented in Sri Lanka from 2006 onwards. The relevance of the policy is assessed by examine the policy goals, objectives, policy statements, and strategies independently. This evaluation was based on the researcher's knowledge and information gathered from various sources related to dairy development. The data required for this evaluation was obtained from the Department of Animal Production and Health, Ministry of Agriculture, State Ministry of Livestock Development and National Livestock Development Board.

The implementation process of the Po considered policies; The strategies used to implement the policies over the last 15 years were examined through interviews and focus group discussions with relevant officials at the field level and other stakeholders.

2.3 Information on Dairy policy – 2006 prepared by Ministry of Livestock Development

Policy goals and targets - achieve sustainable and equitable economic and social benefits; Increase the supply of domestic milk products at competitive prices to the consumers, reach 50% self-sufficiency in milk by 2015.

Policy objectives:

1. Spell out the dairy development goals clearly and define the role of public sector in dairy development activities in the country.
2. Facilitate the private sector and other interested agents to identify the scope and possibilities for production, processing and marketing of milk and dairy products,
3. Rationalizing investments on the dairy sector from the Consolidated Fund and avoid crowding out.

Dairy Development Policy Statements

1. Dairy sector prioritized for public sector investment.
2. Liquid milk market expansion crucial for domestic milk production competitiveness.
3. Upgrading native herd essential for dairy development. Public-private partnership needed.
4. Enhancing buffalo and goat productivity in dairy industry.
5. Government aims to transition subsistence dairy production to a viable commercial activity.
6. Import and fiscal policies will support the domestic dairy industry.
7. Market focus will determine domestic milk pricing, with limited government intervention to enhance market competitiveness.
8. Viable, commercially oriented private sector crucial for long-term dairy industry sustainability.
9. Facilitating dairy farmer empowerment and value chain participation.
10. Priority: Developing feed resources (pasture, forages, grains, waste) for livestock sector.
11. Government facilitates feed ingredient trading, promotes local feed production with protection and incentives.

Dairy Development Strategies

1. Government implements projects, supports small-scale farmers, and catalyses dairy commercialization.
2. Government introduces cost sharing with private entrepreneurs and farmer societies for village-level milk processing, meeting consumer needs, and expanding the market for processed milk.
3. Government introduces cost sharing with the private sector for setting up breeder farms, improving dairy animal breeding, and enhancing the supply of breeding animals.
4. Government promotes milk consumption by making processed milk easily accessible through strategically located milk sales outlets in schools, hospitals, workplaces, etc.
5. Government empowers dairy farmers by organizing them into collective groups, allowing them to make decisions about their dairy production activities.
6. The government supports farmer associations and dairy processors to improve efficiencies in the dairy product value chain.
7. Specially trained officials will collaborate with provincial authorities to achieve self-reliance in milk production.
8. Technology transfer and mechanization will be implemented to improve dairy herd performance and farm productivity, fostering commercial dairy farming.
9. The public sector will support small-scale dairy operators and subsistence farmers to ensure regular dairy income through development programs.
10. Government will prioritize artificial insemination for genetic improvement of native herd; use superior bulls where AI is not feasible for disseminating selected genomes to native cattle and buffalo.
11. Establish national-level coordination for dairy breeding programs to improve herd composition in the industry.
12. National Animal Breeding Committee to guide breeding programs under Ministry.
13. Prioritize buffalo's role in national dairy development.
14. Regular cost and profitability reviews to enhance local dairy industry competitiveness.
15. Increase dairy farmer equity in Milco Pvt Ltd for greater benefits.

16. Popularize compost digestion, biogas, and compost making technologies.

Feed Resource Development Strategies

1. Increase funding for research on ruminant feeding and local feed resources.
2. Introduce salinity-tolerant pastures; utilize salinity-affected lands for livestock rearing.
3. Demonstrate pasture production in paddy fields to extend grazing period.
4. Demonstrate suitable pasture and fodder species, use chaff cutters for higher roughage utilization in ruminant feeding.
5. Harness rice polish, sugar cane tops, bio gas, and crop residues for increased production.
6. Introduce haymaking and silage systems for increased forage availability in dry periods.
7. Introduce and promote technologies for effective paddy straw utilization.
8. Provide state lands for private sector feed and fodder production, demonstrate cultural practices, and implement out-grower operations for animal feed ingredients.
9. Adopt supportive trade and tariff policy for domestic feed ingredient production.
10. Rectify tax incentives for competitive structure in domestic feed milling.

3. Results and Discussion

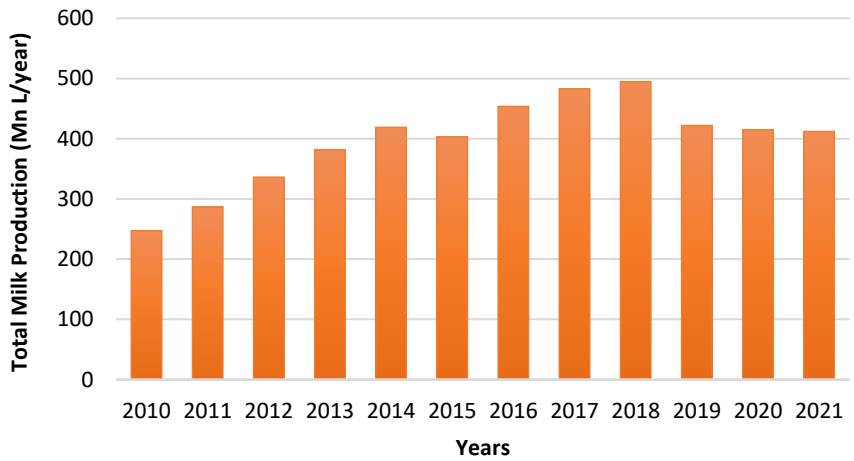
3.1 Relevance of the Policy

The policy document contains 16 dairy development strategies and 10 feed development strategies to achieve sustainable and equitable economic and social benefits in the dairy sector. It focuses on promoting liquid milk consumption, enhancing native herds, and expanding the role of buffalo and goats. The policy aims to transform subsistence-level dairy into commercial viability, addresses import and fiscal policies, governs domestic milk pricing, and encourages private dairy farms' development. It empowers dairy farmers and tackles current challenges effectively.

3.2 Milk Production Enhancement

In the 2006 dairy policy document, there was a clear objective to attain 50% self-sufficiency in milk production by 2015. The primary focus was on improving both cattle and buffalo herds to achieve this goal. The responsibility for offering technical expertise and assistance in herd development lies with the Department of Animal Production and Health (DAPH). It's worth mentioning that the DAPH has implemented various programs aimed at enhancing milk production as part of their herd development efforts.

According to Figure 1, the yearly milk production from 2010 to 2021 exhibited a rising trend until 2018, after which there was a decline in subsequent years. The drop in production during those years can be attributed to the significant increase in the cost of concentrate feed. As a result, the overall milk production in 2021 decreased considerably. Additionally, the Department of Animal Production and Health (DAPH) reported that in 2018, the country achieved only 40% self-sufficiency in milk production. However, in 2006, the policy was targeted to achieve the 50% of the self-sufficiency in 2015 and it is clear that the targeted production achievements have not been fulfilled in the respective years.



Source: Department of Animal Production and Health

Figure 1: Total Annual Milk Production from 2010 to 2021

3.3 Role of Public Sector in Dairy Development

According to the 2006 Dairy Policy, public sector support for the livestock industry in Sri Lanka is primarily provided by the Department of Animal Production and Health (DAPH), which serves as the key institution offering technical leadership to the sector and its stakeholders. The Animal Health Division of the DAPH plays a central role by providing technical guidance and support services aimed at preventing the introduction of exotic diseases, as well as controlling and eradicating existing economically significant and zoonotic diseases within the country. In addition, the Division is responsible for maintaining animal welfare standards and ensuring the safety of food products of animal origin. The Animal Health Division is comprised mainly of two specialized units: the Veterinary Epidemiology Unit and the Veterinary Public Health Unit.

Animal breeding division is responsible for national level livestock genetic improvement through facilitation of appropriate breeding techniques and logistic support. Deep frozen semen is produced at Kundasale and Polonnaruwa Artificial Insemination Centers for Artificial Insemination (AI) of cattle, buffalo and goat. In addition, field AI programs are facilitated by supplying semen of specific genetic merits imported from other sources. Sexed semen is also supplied to the provinces on demand.

Veterinary Research Institute (VRI) is the research arm of the DAPH and is involved in veterinary research, diagnostic and analytical testing, consultancy, providing expertise for national and regional committees, regulatory and statutory functions, teaching and technology transfer activities in the livestock sector.

Genes exert a profound influence on milk production traits by determining their heritability and potential for transmission across generations (Sammy, 2012). In contemporary dairy breeding programs, selection decisions are increasingly based on genetic merit rather than solely on observable phenotypic traits. Genetic merit represents the estimated potential of desirable characteristics being inherited by the offspring, thereby serving as a more reliable indicator for long-term genetic improvement (Sammy, 2012). The 2006 National Dairy Policy of Sri Lanka identified Artificial

Insemination (AI) as a key strategy to enhance genetic progress within the national dairy herd. Over the past fifteen years, the implementation of AI has expanded substantially, reflecting the government's commitment to improving reproductive efficiency and productivity.

Nevertheless, the proportion of successful pregnancies and calvings remains lower than the total number of AI procedures performed, largely due to factors such as multiple insemination attempts, variable semen quality, and management-related constraints. Moreover, incomplete reporting of pregnancy diagnoses and calving data has limited the accuracy of performance monitoring in some herds. To address these challenges, the Heifer Cow Program has established structured reporting mechanisms that ensure more comprehensive data collection. This program also provides feed subsidies for female calves up to their first calving, thereby encouraging compliance with record-keeping protocols and promoting sustainable genetic improvement through effective reproductive management.

3.4 Animal Breeding Performances

Table 1 presents longitudinal data on the number of artificial inseminations (AIs), pregnancy diagnoses (PDs), and calving's resulting from AI in Sri Lanka from 2007 to 2020, based on annual reports of the Department of Animal Production and Health (DAPH). This dataset provides valuable insights into the trends and performance of bovine reproductive management practices implemented over the 14-year period.

The total number of AIs conducted during this period was 2,770,588, indicating a substantial effort by the national livestock development programs to enhance genetic improvement and reproductive efficiency in the dairy sector. AIs increased markedly between 2007 and 2016, rising from 94,960 in 2007 to a peak of 245,265 in 2016. However, a slight decline was observed thereafter, with AI numbers decreasing to 202,516 by 2020. This pattern suggests a possible plateau in AI expansion or the emergence of implementation challenges in the latter years.

Pregnancy diagnosis, a key component of post-insemination reproductive monitoring, showed a broadly parallel trend, increasing from 24,172 diagnoses in 2007 to a peak of 75,043 in 2016, and then stabilizing around 70,000 annually until 2019, before declining to 59,877 in 2020. The cumulative number of pregnancy diagnoses over the period was 755,486, demonstrating efforts to track conception rates and reproductive outcomes more effectively. Nevertheless, data gaps, such as the absence of PD data for 2009, limit comprehensive year-on-year assessment.

Table 1: Number of AI, Pregnancy Diagnosis and Number of Carvings Reported

Year	Number of AI done	Number of Pregnancy Diagnosis done	Number of carvings resulted in from AI
2007	94,960	24,172	10,800
2008	165,853	44,813	40,659
2009	172,319	-	51,581
2010	177,000	48,572	57,334
2011	181,725	45,905	56,144
2012	203,753	49,798	66,860
2013	216,660	57,010	71,878
2014	205,949	66,908	51,781
2015	228,890	66,493	63,296
2016	245,265	75,043	68,975
2017	234,924	70,347	66,184
2018	229,418	74,101	69,520
2019	211,356	72,447	66,157
2020	202,516	59,877	57,051
Total	**2,770,588**	**755,486**	**734,924**

Note: In certain years, the number of calvings resulting from AI exceeds the number of recorded pregnancy diagnoses. This discrepancy occurs because many successful pregnancies resulting from AI were not formally confirmed through a pregnancy diagnosis procedure but proceeded to a successful calving.

Source: Annual Reports DAPH, Various Years

Calving's resulting from AI interventions totaled 734,924 over the study period. The number of AI-derived calving rose steadily from 10,800 in 2007 to a maximum of 71,878 in 2013, indicating significant reproductive success during this phase. The highest number of calving after 2013 occurred in

2018 (69,520), despite a slight decrease in AI numbers, potentially reflecting improvements in AI efficiency or animal management practices.

The overall AI-to-calving ratio during the study period reflects an average success rate of approximately 26.5%, consistent with benchmarks reported in comparable developing-country contexts. However, annual variations in efficiency indicate that factors such as semen quality, technician competence, heat detection accuracy, and the overall health and nutritional status of animals play a critical role in determining reproductive performance.

The data indicate that although Sri Lanka has made significant progress in expanding AI services and improving reproductive performance through structured breeding programs, several challenges persist. These include variability in AI success rates, inconsistencies in pregnancy diagnosis coverage, and occasional gaps in data completeness. Strengthening service delivery mechanisms, enhancing technical capacity, and improving data management and reporting systems are essential to further optimize reproductive efficiency and promote sustainable growth within the national dairy sector.

3.5 Semen Production and Importation – Neat Cattle

Table 2 shows semen quantities from 2008 to 2020, with significant local production of Jersey, Frisian, Sahiwal, and Crossbred semen. Jersey semen is widely used in the upgrading program, followed by Frisian and Crossbred. Department of Animal Production and Health (DAPH) emphasizes breed selection based on climatic zones. For wet zones, Jersey and Frisian are recommended, and Sahiwal and AFS for dry zones. However, grassroots farmers often choose semen based on personal preferences or availability, potentially impacting genetic improvement and breeding outcomes.

Semen production and importation represent critical components of bovine genetic improvement programs aimed at enhancing dairy productivity in Sri Lanka. Table 3 presents data from the Department of Animal Production and Health (DAPH) for the period 2008 to 2021, detailing the annual number of semen doses produced locally and imported for four major cattle types:

Jersey, Friesian, Sahiwal, and Crossbreeds. This dataset provides valuable insights into national breeding strategies, breed preference trends, and reliance on foreign genetic resources over time.

3.5.1 Locally Produced Semen

During the 14-year period, a total of 3,468,781 doses of semen were produced locally, with the highest proportion allocated to Jersey (1,919,960 doses), followed by Friesian (698,408 doses), Sahiwal (195,339 doses), and Crossbreeds (651,074 doses). This distribution reflects a strategic emphasis on Jersey genetics, widely recognized for their adaptability to local agro-climatic conditions, relatively high milk fat content, and moderate input requirements.

Table 2: Semen Production and Importation of Neat Cattle

	No. of Locally Produced (doses)				No. of Imported (doses)			
Year	**Jersey**	**Friesian**	**Sahiwal**	**Cross Breeds**	**Jersey**	**Friesian**	**Sahiwal**	**Cross breed**
2008	106,967	25,635	10,160	28,225	38		4,087	
2009	86,256	15,450	2,798	34,240			3,651	751
2010	104,226	37,170	17,201	35,117				
2011	103,757	34,830	17,403	38,290	3,500	900		
2012	136,940	41,534	18,735	26,899	3,500	3,982		
2013	157,535	28,865	24,720	32,811				4,990
2014	165,769	125,790	23,240	47,194				
2015	116,843	153,015	22,030	69,040	500			
2016	170,385	90,653	22,124	73,063	500			
2017	124,773	68,655	24,090	82,310	900	500		1,000
2018	183,199	16,964	11,986	81,742	986		2,996	3,982
2019	210,341	11,149		10,670	2,453	3,478		
2020	144,079	16,325		3,434				
2021	108,890	32,373	852	88,039	107		114	
Total	**1,919,960**	**698,408**	**195,339**	**651,074**	**12,484**	**8,860**	**10,848**	**10,723**

Source: Annual Reports DAPH (year/s 2008-2021)

Annual local production volumes showed moderate fluctuations but a general upward trend, peaking in 2019, when over 210,000 doses of Jersey semen were produced. Friesian semen production also peaked in 2015

(153,015 doses) and 2014 (125,790 doses), likely aligned with targeted interventions to increase the genetic potential of dairy herds for higher milk yields. Production of Sahiwal and crossbred semen was also maintained at significant levels, underlining efforts to improve heat tolerance, disease resistance, and adaptability among local cattle populations through indigenous or composite breeds.

The increase in local production reflects not only the expansion of national semen collection and processing centers but also enhanced technical capacity and policy emphasis on reducing dependency on imports through domestic genetic resource management.

3.5.2 Imported Semen

Despite the expansion of local production, Sri Lanka continued to supplement its genetic base through imports, particularly for specific breeds or advanced genetic traits unavailable locally. A total of 42,915 doses of imported semen were recorded between 2008 and 2021. The largest quantities were for Sahiwal (10,848 doses) and Crossbreeds (10,723 doses), followed closely by Friesian (8,860 doses) and Jersey (12,484 doses).

The volumes of imported semen varied annually and were relatively low compared to domestic production, indicating a strategic and selective use of foreign genetics. Peaks in importation were observed in 2008, 2011, 2018, and 2019, with targeted imports of Friesian and Jersey semen likely to enhance breed purity, diversify genetic lines, or access elite performance traits (e.g., high milk yield or improved reproductive efficiency). The importation of Sahiwal semen was consistent across several years, reflecting continued demand for tropical dairy cattle genetics with proven resilience and productivity under low-input conditions.

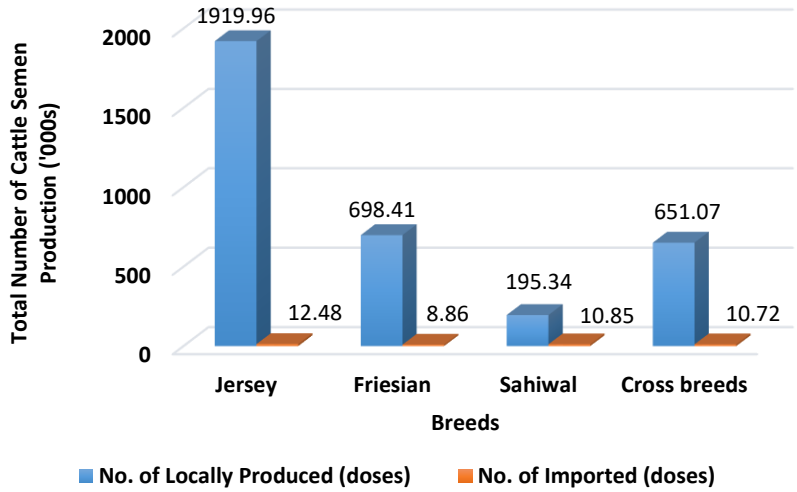
In 2017 and 2018, small quantities of crossbred semen were imported, possibly to strengthen hybrid vigor in specific breeding programs or test new composite lines for adaptability and performance.

The data indicate a strong dependence on locally produced semen, particularly for Jersey and Friesian breeds, while imported semen continues

to be used selectively and strategically. This pattern aligns with Sri Lanka's national livestock development goals, which emphasize self-sufficiency, cost-effectiveness, and the conservation of locally adapted cattle genotypes. The substantial use of crossbred semen-both locally produced and imported-reflects an ongoing effort to balance productivity with adaptability, particularly within smallholder production systems.

Over time, Sri Lanka's genetic improvement strategy has evolved to support a diversified breeding framework that integrates high-yielding exotic breeds with resilient indigenous types. This approach aims to optimize milk production across the country's varied agro-ecological zones. The growing reliance on artificial insemination (AI) as the principal breeding method, together with the expansion of national semen production capacity, demonstrates a positive trend toward sustainable genetic improvement and enhanced herd productivity.

However, periodic semen importation remains vital for maintaining genetic diversity, reducing inbreeding risks, and introducing elite traits that may not yet exist within local breeding programs. Moving forward, the success of this dual strategy-strengthening domestic semen production while strategically incorporating imports-will depend on sustained investment in AI infrastructure, continuous training of technicians, effective animal recording and data management systems, and better alignment with farmer needs and regional production environments.



Source: Annual Reports DAPH (Year/s)

Figure 2: Quantities of Locally Produced Cattle Semen during Past 15 Years

The figure 2 illustrates, when consider jersey type cattle, locally produced 1,919,960 doses and imported ones produced 12,484 doses. The locally produced Jersey semen significantly outweighs the imported semen, indicating a strong preference or higher availability of Jersey cattle breeding stock within the local context. Similarly, the locally produced Friesian semen surpasses the imported semen, suggesting a strong presence or demand for Friesian cattle breeding within the region. The data reveal that locally produced Sahiwal semen surpasses imported semen, highlighting the breed's popularity and suitability for local breeding programs. Similarly, for crossbred cattle, the use of locally produced semen exceeds that of imported semen, indicating a strong preference for or successful adoption of crossbreeding strategies utilizing indigenous genetic resources. Overall, the findings demonstrate a consistent preference for locally produced semen across all analyzed breeds-Jersey, Friesian, Sahiwal, and crossbreeds. This trend may be attributed to factors such as greater availability, cost-effectiveness, and superior adaptability of locally bred animals to regional production environments. Although imported semen contributes valuable genetic diversity, the predominance of local semen use reflects growing confidence in national breeding programs and the proven suitability of local genotypes for sustainable cattle production in Sri Lanka. Although locally produced semen remains the preferred choice, imported semen still

attracts demand. Nevertheless, higher costs and associated logistical expenses may limit its utilization among farmers and breeding programs.

3.6 Upgrading Native Herd

The Ministry of Livestock Development has undertaken projects to upgrade native herds, focusing on breeder farms and importing high-yielding animals from New Zealand and Australia. From 2015 to 2020, 658 breeder farms were established, and 20, 000 animals were planned to import to enhance genetic potential and productivity. These efforts aim to improve the overall livestock sector performance. However, despite significant investments in dairy production enhancement, the importation of over 1500 improved cattle did not achieve the expected results, leading to limited success.

3.7 Disease Control and Vaccination Programme

The control of livestock diseases through vaccination has been a central component of Sri Lanka's national animal health strategy. From 2008 to 2021, the Department of Animal Production and Health (DAPH) implemented extensive vaccination programs targeting key endemic and economically significant diseases, including Foot and Mouth Disease (FMD), Hemorrhagic Septicemia (HS), Black Quarter (BQ), and Bovine Brucellosis. In addition, imported FMD vaccines were utilized strategically during years of heightened risk to supplement local supply.

Foot and Mouth Disease (FMD) received the most significant attention, with a total of 7,216,056 vaccine doses supplied over the 14-year period. Vaccination coverage increased markedly over time, peaking in 2019 with 970,160 doses, followed closely by 947,610 doses in 2018. However, a substantial decline occurred in 2020, where only 226,600 doses were distributed, likely due to disruptions related to the COVID-19 pandemic. A partial recovery was observed in 2021, with 775,090 doses administered. In response to FMD outbreaks and increased disease risk, Sri Lanka also imported a total of 1,875,000 vaccine doses during 2014–2017. The highest volume of imports occurred in 2014 (675,000 doses), followed by 600,000 doses each in 2015 and 2017. These targeted imports reflect the government's commitment to rapid containment and eradication efforts.

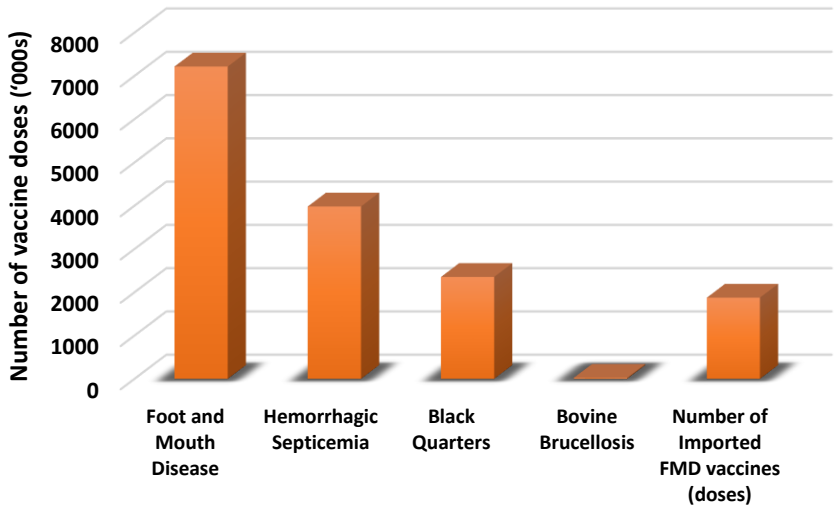
Hemorrhagic Septicemia (HS), a bacterial disease with high mortality among cattle and buffalo, was also addressed with significant vaccination coverage. Over the study period, 3,981,854 vaccine doses were supplied. The highest annual administration occurred in 2008 (1,020,000 doses) and 2017 (835,557 doses), indicating periods of intensified disease control. However, several years lack reported data, including 2010, 2013–2016, and 2018, limiting the ability to assess long-term consistency. More recently, the number of HS vaccinations declined, with 303,600 doses in 2019, 351,010 in 2020, and just 139,524 doses in 2021. These trends point to either shifting program priorities or the impact of operational disruptions in the veterinary services sector.

Vaccination against Black Quarter (BQ), another bacterial disease affecting cattle, was carried out with a total of 2,353,860 doses administered between 2008 and 2021. The highest coverage was recorded in 2012 (244,134 doses) and 2008 (195,822 doses). In recent years, the number of doses supplied has declined. For instance, in 2020 and 2021, only 146,619 and 91,780 doses were administered, respectively. The observed reduction in vaccine distribution may reflect improved disease control status in certain regions, limitations in vaccine availability, or resource diversion to higher-priority diseases.

Bovine Brucellosis, a zoonotic disease with serious implications for both animal and public health, received the lowest vaccine coverage among the diseases tracked. Only 25,001 doses were reported over the 14-year period, with annual vaccinations ranging from 3,298 to 5,984 doses. The most active years were 2015 and 2016, but coverage in subsequent years remained minimal. The low scale of vaccination may be due to targeted immunization efforts in specific high-risk herds or geographic areas, limited resource allocation, or underreporting. Nonetheless, given the zoonotic potential of Brucellosis, there is a strong rationale for reviewing and potentially expanding this component of the vaccination program.

Overall, the data reflect Sri Lanka's sustained commitment to livestock disease prevention through vaccination, with a clear focus on controlling FMD and HS. The use of both locally produced and imported vaccines demonstrates a capacity for flexible response during outbreak situations.

However, inconsistencies in data reporting and reduced vaccination coverage for several diseases in recent years, especially during the pandemic, highlight the need for improved disease surveillance, data management, and logistical planning. Strengthening cold chain systems, enhancing veterinary workforce capacity, and integrating One Health principles, particularly in the case of Brucellosis, are essential steps for ensuring more effective and resilient disease control strategies in the future.



Source: DAPH Annual Reports (Year/s)

Figure 3: Disease Control and Vaccination Program Details from 2008 to 2021

Figure 3 explains the cumulative number of vaccine doses supplied for major livestock diseases in Sri Lanka from 2008 to 2021, based on data compiled from the Annual Reports of the Department of Animal Production and Health (DAPH). The figure highlights the scope and scale of vaccination efforts undertaken to protect the national herd from highly contagious and economically significant diseases. It also includes data on imported Foot and Mouth Disease (FMD) vaccines, representing additional strategic measures to strengthen disease control.

The most extensive vaccination coverage during the period was recorded for Foot and Mouth Disease (FMD), with a total of 7,216,056 doses administered. FMD is a highly contagious viral disease affecting cloven-

hoofed animals, including cattle, buffalo, pigs, sheep, and goats. Its economic impact is considerable, stemming from reduced productivity, trade restrictions, and the costs associated with disease control measures. The substantial volume of vaccines supplied highlights the prioritization of FMD within national livestock disease control strategies and reflects the persistent risk of outbreaks across multiple regions of Sri Lanka.

To supplement domestic vaccine production and meet urgent disease control requirements, a total of 1,875,000 FMD vaccine doses were imported between 2014 and 2017. These imported doses were likely targeted to specific FMD serotypes or deployed to support large-scale emergency vaccination campaigns in high-risk zones. Vaccination programs were strategically designed to achieve broad herd immunity, particularly in regions with high livestock density or a history of recurrent outbreaks. Routine vaccination schedules, combined with emergency responses, aimed to reduce transmission, minimize economic losses, and safeguard both local and export-oriented livestock sectors.

The success of these programs depends not only on vaccine availability but also on effective delivery, monitoring, and farmer participation. Efforts to raise awareness among livestock owners, provide technical support to veterinary officers, and integrate vaccination campaigns with other animal health initiatives have been critical to improving overall coverage and disease prevention. These measures collectively strengthen the resilience of the national livestock population against FMD and contribute to long-term productivity and economic stability.

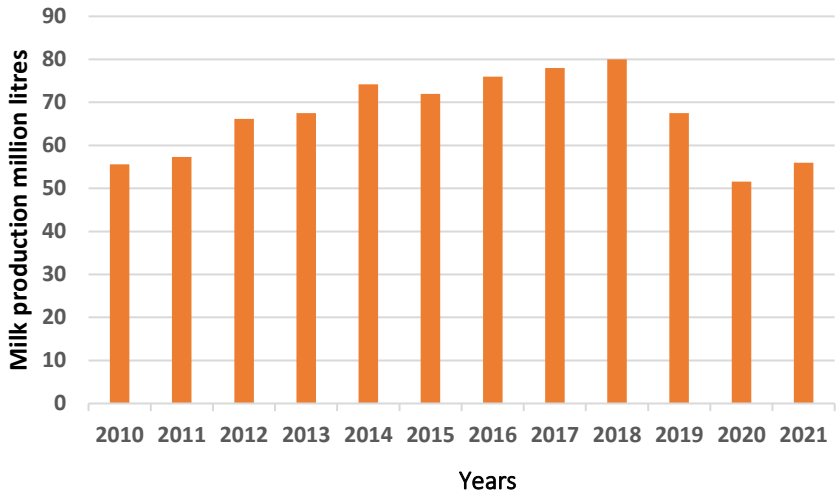
Hemorrhagic Septicemia (HS) was the second most vaccinated disease during the reference period, with a cumulative 3,981,854 doses supplied. HS is a bacterial disease caused by *Pasteurella multocida* and is primarily fatal in cattle and buffaloes, especially during the monsoon season. The high vaccination numbers signify the disease's endemic nature and the need for preventive coverage across susceptible regions to mitigate seasonal outbreaks and associated livestock mortality.

Black Quarter (BQ), another acute bacterial disease caused by *Clostridium chauvoei*, accounted for 2,353,860 vaccine doses administered over the

period. Characterized by rapid onset, muscle necrosis, and high fatality, BQ affects primarily young cattle. Although the total volume is lower than for FMD and HS, the consistent annual inclusion of BQ in the national vaccination program highlights its recognized threat to livestock productivity and rural incomes.

In contrast, Bovine Brucellosis vaccination was implemented on a much smaller scale, with only 25,001 doses administered between 2008 and 2021. Brucellosis, caused by *Brucella abortus*, is a zoonotic disease that leads to abortion, infertility, and reduced milk production in cattle, while also posing significant public health risks. The relatively low volume of vaccines suggests that immunization efforts were likely targeted toward specific high-risk herds or regions, potentially as part of pilot control programs. Given both its zoonotic potential and its substantial economic impact on livestock productivity, the limited scale of vaccination underscores the need for renewed policy focus, greater resource allocation, and strategic investment in comprehensive brucellosis control measures.

Overall, Figure 3 underscores Sri Lanka's sustained investment in livestock health management through vaccination. The data reflect not only the prioritization of specific diseases like FMD and HS but also the integration of both domestic and imported vaccine strategies to achieve national disease control objectives. These vaccination programs have played a critical role in safeguarding animal health, enhancing productivity, and supporting the livelihoods of thousands of smallholder farmers who depend on livestock as a primary or supplementary income source.



Source: Department of Animal Production and Health, 2021

Figure 4: Annual Buffalo Milk Production from 2010- 2021

Figure 5 shows that the annual buffalo milk production in Sri Lanka from 2010 to 2023, measured in million liters. Over the 14-year period, two distinct trends are observed: a phase of steady growth followed by a notable decline and subsequent stabilization.

From 2010 to 2018, buffalo milk production showed a consistent upward trajectory, increasing from approximately 56 million liters in 2010 to a peak of 80 million liters in 2018. This growth period reflects the improvements in animal breeding, veterinary services, feeding practices, and policy support for livestock development.

However, beginning in 2019, production began to decline sharply, dropping to 68 million liters. The downward trend continued into 2020, reaching a low of approximately 52 million liters. This decline coincides with the onset of the COVID-19 pandemic, which likely disrupted supply chains, reduced access to inputs and services, and impacted overall farm operations.

Between 2021 and 2023, production showed signs of stabilization, fluctuating slightly around 53–56 million liters annually. Despite this modest recovery, the production levels have yet to return to the pre-2019 peak, indicating ongoing structural or operational challenges in the buffalo milk sector.

This pattern highlights the sector's vulnerability to external shocks and the need for resilient strategies to sustain and enhance buffalo milk production in the long term.

3.8 Projects and Programmes Implemented to Enhance the Buffalo Milk Production

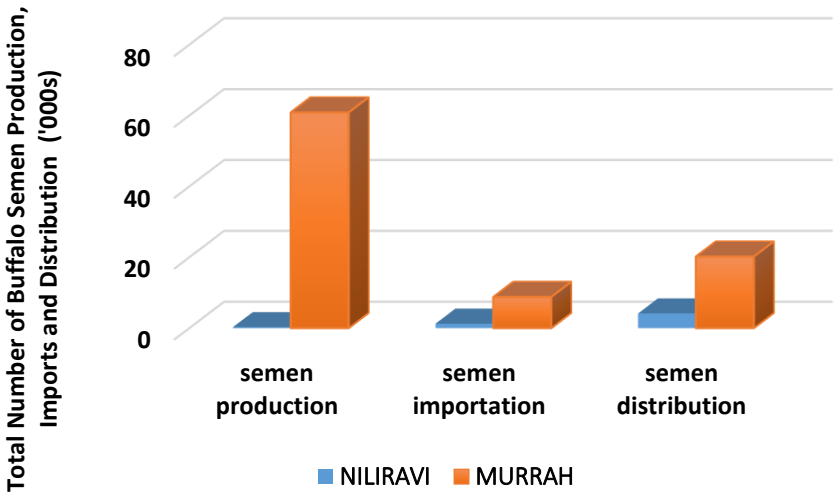
The Department of Animal Production and Health (DAPH) has initiated several projects and programmes aimed at enhancing buffalo milk production in Sri Lanka. A major focus of these initiatives is the genetic improvement of the national buffalo herd through a structured crossbreeding programme. This involves upgrading local buffaloes by introducing superior dairy breeds, primarily Murrah and Niliravi, to improve traits such as milk yield, body size, temperament, and adaptability to local environments.

The genetic upgrading process is carried out in stages. Initially, local buffaloes (common breeds) are crossed with purebred animals (such as Murrah or Niliravi), producing first-generation (F1) offspring that are 50% genetically pure. These F1 animals are then bred with purebred animals again, producing second-generation offspring that are 75% (¾) pure. The third generation is achieved by crossing ¾ pure animals with purebred ones, resulting in animals that are 87.5% (7/8) pure. This gradual breeding process helps retain the beneficial traits of local breeds while moving closer to the characteristics of high-performing dairy breeds.

Among the improved breeds, Murrah buffaloes are given particular emphasis due to their higher milk-producing potential. Over the past 15 years, there has been a steady increase in the production of Murrah and Niliravi semen within the country. This growth has been supported by significant infrastructure development at key semen production stations. The Kundasale and Polonnaruwa stations have been upgraded with advanced technologies, while a new facility has been established in Thinnaveli for chilled semen production. These enhancements have strengthened the capacity of artificial insemination (AI) services across the country.

Further, the Kundasale Insemination Station has been developed to meet international standards, improving the quality and reliability of AI services. To support reproductive success, especially in dry and intermediate zones, DAPH has implemented an Oestrous Synchronization Programme. As part of this programme, 162 buffaloes were treated with the $PGF_2\alpha$ hormone to induce heat, allowing for better timing and success rates in insemination.

These interventions by DAPH demonstrate a comprehensive approach to improving buffalo milk production in Sri Lanka. By combining genetic upgrading, improved infrastructure, and advanced reproductive technologies, the department aims to build a more productive and resilient buffalo dairy sector.



Source: Annual Reports DAPH

Figure 5: Buffalo Semen Production, Importation and Distribution

When consider about Niliravi, the relatively low semen production figure 6 suggests that there may be limited breeding stock or lower demand for Niliravi semen. The higher importation figure compared to production indicates a higher reliance on imported semen to meet breeding demands. The high distribution figure implies that there is significant demand for Niliravi semen, potentially for breeding purposes or artificial insemination programs. The significantly higher semen production figure for Murah indicates a robust breeding program or higher demand for Murah semen compared to Niliravi. The lower importation figure suggests that the Murah breed has less reliance on imported semen, potentially due to sufficient

domestic production capacity. The distribution figure indicates a substantial demand for Murah semen, likely for breeding purposes to improve cattle genetics or meet market demand for Murah cattle. This data highlights differences in semen production, importation, and distribution between the Niliravi and Murah cattle breeds. It suggests potential differences in breeding programs, demand for semen, and reliance on imported genetic material.

Artificial Insemination (AI) training programs and the distribution of bull calves over 15 years to improve buffalo herd performances. There have been 1019 AI training programs to enhance breeding practices, although there were certain years without AI training. Authorities also promoted natural breeding by providing 254 bull calves (Murrah and Niliravi breeds) to medium-scale farms. This initiative aims to contribute to genetic improvement and further enhance buffalo dairy development.

The relatively high number of participants trained suggests that there is significant interest or investment in training programs related to cattle management, breeding, or other related activities. Training programs aimed at improving the skills and knowledge of farmers, agricultural workers, or individuals involved in the cattle industry. The large number of participants trained indicates a potential effort to enhance productivity, efficiency, and sustainability in the cattle sector through capacity building and skill development initiatives. Although 1019 participants trained for AI only 254 bull calves were issued. Overall, while the number of participants trained for AI may exceed the number of bull calves issued, various factors such as availability, quality standards, resource constraints, timing, demand, and program objectives can influence the discrepancy between the two figures.

3.9 Farmer Empowerment Programs

The Department of Animal Production and Health (DAPH) has implemented ongoing farmer empowerment programs to strengthen dairy farming in Sri Lanka, focusing on building technical knowledge and practical skills. In collaboration with the Ministry of Livestock Development, Milco, the NLDB, and other stakeholders, these initiatives include training workshops, educational booklets, and television broadcasts to disseminate best

practices. Targeted support such as milking cow subsidies and women's empowerment programs further enhances participation and capacity among smallholder farmers. While these interventions have improved technical competencies and productivity, persistent challenges—including limited access to quality inputs and weak market linkages—highlight the need for continued policy reinforcement and multi-stakeholder engagement to achieve sustainable sector growth.

3.10 Promoting Liquid milk market

Promoting liquid milk consumption has been a central policy objective in Sri Lanka, with all livestock sector institutions playing a role and the Ministry of Livestock Development providing strategic leadership. The Ministry has spearheaded initiatives to establish milk outlets, modernize processing centers, provide financial support, and assist dairy cooperatives, all aimed at encouraging the consumption of liquid milk and fostering growth in the dairy industry.

Several targeted programs have been implemented over the years to support these objectives. In 2012, efforts were made to establish 656 milk outlets to improve accessibility to liquid milk. By 2015, priority was given to strengthening the island-wide milk collection network and distributing 10-liter milk cans to farmers, with allocations of Rs. 3.1 million and Rs. 30 million, respectively. In 2016, initiatives focused on enhancing milk quality among small-scale farmers through financial assistance and the establishment of a Dairy Processing Plant at Badalgama, supported by Rs. 10 million in funding.

Subsequent efforts in 2018 included distributing dairy cows to female-headed households and promoting milk consumption through the production of value-added dairy products. Farmers also received subsidies for laying concrete floors in cattle sheds and other supportive measures, totaling Rs. 46.31 million. In 2019, emphasis shifted toward developing Mini Dairy Cooperative Societies, supported by an allocation of Rs. 2,065 million. Collectively, these programs have contributed to improving milk consumption, enhancing dairy farming practices, and strengthening the

socio-economic well-being of dairy farming communities across the country.

3.11 Animal Feed Resources Development

Under the policy of animal feed resource development, the following statements have been made:

1. The primary focus is on the development of the feed resource base, which includes pastures, natural forages, coarse grains, agricultural waste, and by-products. This is considered a crucial aspect in the overall development of the livestock sector.
2. The government will actively support and encourage the trading of feed ingredients for the livestock industry. Simultaneously, they will provide sufficient protection and incentives to promote the local production and growth of feed resources within the country.

3.12 Projects and programmes Implemented during 2006 to 2020

Over the past 15 years, the Sri Lankan government has undertaken substantial measures to strengthen the dairy feed resource base, addressing a critical constraint in domestic milk production. Key initiatives include the establishment of 773 acres of new pasture lands and large-scale planting of *Gliricidia* sticks by the National Livestock Development Board (NLDB). To promote sustainable fodder utilization, pasture development programs were introduced in private breeder farms, with dedicated fodder plots established as early as 2008. Research and extension efforts focused on cultivating high-yield fodder varieties such as CO-3 and *Brachiaria* at key Artificial Insemination (AI) centers in Kundasale and Polonnaruwa. Additionally, the Animal Breeding Division conducted specialized training programs on fodder cultivation, maintenance, and utilization, benefiting dairy farmers, Livestock Development Officers (DAPH), and MILCO extension staff. To ensure consistent feed supply, 16 registered animal feed manufacturers produced over 6,575 metric tons of cattle feed in 2009, supported by policies facilitating feed import licensing. Further interventions included annual pasture development programs, hay production promotion with grass conservation equipment, and the provision of irrigation infrastructure for pasture lands in Kundasale. These

collective efforts have contributed to improving feed availability, though challenges such as seasonal variability and farmer adoption rates remain areas for further policy focus.

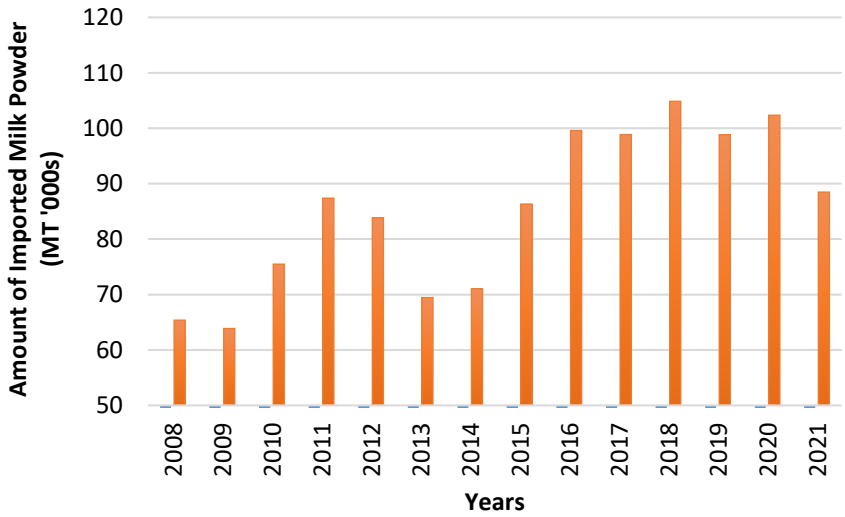
The 2006 policy emphasized feed resource development programs, mainly focused on government agencies, with limited attention to individual farmers. Small-scale dairy farmers in Sri Lanka face challenges with limited land for grazing, resorting to roadside grazing and fallow lands. To improve feed conversion efficiency and support dairy entrepreneurship, tailored feed resource development programs are needed for small-scale farmers, including training to optimize available resources. While the government focused on forage production, enhancing concentrate feed ingredients like maize and soybean lies with the Department of Agriculture. A fertilizer issue in 2021 led to lower maize production and higher animal feed prices. Addressing land issues at the smallholder level and improving grass resource quality are vital aspects.

Over the years, Sri Lanka has undertaken various projects and activities aimed at feed resource development and increasing local animal feed production, alongside providing incentives to support these endeavours. Beginning in 2006, initiatives such as the Pasture and Fodder Development Program focused on establishing new pastures and distributing Glyricidia sticks. Subsequent years saw the distribution of minerals-molasses blocks, promotion of fodder and pasture utilization, and training programs on fodder cultivation and maintenance. By 2009, efforts were made to promote fodder utilization through training programs, with a significant increase in the number of registered animal feed manufacturing establishments. Subsequent years witnessed the implementation of pasture and fodder cultivation programs, development of provincial-level nurseries, and the establishment of fodder banks. Furthermore, equipment provision for grass conservation and financial assistance for pasture improvement were extended. Renewals and new licenses for animal feed manufacturing and imports were facilitated, with a focus on enhancing local production capacity. In 2020, initiatives continued with the establishment of sprinkler irrigation systems and rehabilitation of pasture lands. These concerted efforts signify the government's commitment to promoting self-sufficiency

in animal feed production and bolstering the livestock sector's resilience and sustainability in Sri Lanka.

3.13 Imports of Milk and Milk Based Products

The data from the Department of Animal Production and Health (DAPH) between 2008 and 2021 provides valuable insight into Sri Lanka's trends in dairy product imports, changes in import volumes, and annual budget allocations for the dairy sector. Figure 9 reflects how national policies, global market conditions, and local production capabilities have shaped the country's reliance on imported dairy products and its financial commitments to support the industry.



Source: Department of Customs 2021

Figure 6: Milk Powder Imports (2008-2021)

From 2008 to 2011, Sri Lanka experienced a steady rise in dairy imports and corresponding budget allocations. In 2008, the country imported 65,376 metric tons (MT) of dairy products, a 6.7% increase from the previous year, with an allocation of Rs. 30.8 billion. Although imports declined slightly in 2009 to 63,873.5 MT, the value dropped by 40%, possibly due to falling global prices. In 2010 and 2011, import volumes surged, reaching 87,381.6 MT by 2011. During this time, government allocations increased steadily,

reflecting a strong policy focus on meeting domestic demand through imports.

Between 2012 and 2015, import volumes fluctuated, while budget allocations were inconsistent. In 2012, dairy imports declined by 4.08% compared to the previous year, but the allocation rose to Rs. 39 billion. In 2013, imports dropped more significantly by 17.13%, and the budget allocation fell drastically to just Rs. 0.37 billion possibly due to a shift in priorities or a reporting anomaly. In 2014, imports slightly increased, and the allocation rebounded to Rs. 44 billion. However, by 2015, although import volumes rose sharply by 21.5%, budgetary support again dropped to Rs. 0.34 billion, suggesting either a shift in expenditure methods or limited public investment during that year.

From 2016 to 2020, both import volumes and government allocations grew steadily. In 2016, imports increased to 99,593.4 MT, a 15.3% rise from 2015, while the allocation rose to Rs. 36.33 billion. Despite a minor decline in imports in 2017, budget support increased to Rs. 48.15 billion. In 2018, imports reached their highest level of the period at 104,861.9 MT, and allocations climbed to Rs. 54 billion. Although 2019 saw a drop in imports to 98,837.8 MT, financial support continued to grow, reaching Rs. 55.65 billion. In 2020, imports slightly increased, and the government allocated Rs. 61.93 billion, likely due to concerns over food security during the COVID-19 pandemic.

The period from 2021 to 2023 was marked by a shift in trends, with import volumes decreasing but costs rising. In 2021, imports declined by 15.7% compared to 2020, falling to 88,481.8 MT. However, the value of imports rose by approximately Rs. 1 billion, indicating an increase in global prices or a change in the type of products imported. The budget allocation stood at Rs. 63.09 billion. In 2022, imports dropped even further by 40% to 53,757.9 MT, yet the cost increased by another Rs. 5 billion. The budget rose to Rs. 68.32 billion, reflecting rising expenses in securing dairy products. In 2023, imports rose again by 32% to 71,180.2 MT, and the value spent increased by Rs. 20 billion compared to 2022. This was accompanied by the highest budget allocation in the 16-year period, amounting to Rs. 88.62 billion.

Overall, the data highlight Sri Lanka's continued heavy reliance on imported dairy products to satisfy domestic demand, despite longstanding efforts to expand local production. This dependence not only exposes the country to volatile global prices but also imposes a significant financial burden on public resources. While budget allocations for dairy development have generally increased; particularly after 2016-historical inconsistencies underscore the need for sustained, strategically targeted policies rather than ad hoc interventions. Strengthening domestic dairy production through enhanced breeding programs, improved feed and nutrition systems, modern infrastructure, and comprehensive farmer training is essential. Such measures would reduce reliance on imports, safeguard national food security, stabilize government spending, and support rural economic development. A coordinated, long-term approach that integrates technology adoption, market access, and capacity building is critical to transform the sector into a **s**elf-reliant and resilient industry, ensuring both economic and nutritional benefits for the country.

3.14 Evaluation of Dairy Development Strategies

Table 3 explains the strategies implemented by different organizations and their current situation.

Table 3: Strategies Implemented by Different Organizations and their Current Situation

	Strategy	Current Situation
1.	Supporting small-scale dairy farmers, promoting commercialization where possible.	Focus on enhancing existing farmers' production, limited commercialization of dairy farms.
2.	Government introduces cost sharing with private entrepreneurs, farmer societies, and cooperatives for village-level liquid milk processing, expanding the market and ensuring access to hygienic milk in rural areas.	Relevant strategy for dairy industry, promotes liquid milk over powdered milk, low-cost and efficient with existing processing and transport, supported by private entrepreneurs and cooperatives, but distribution challenges remain.
3.	Similar cost sharing arrangements with the private sector will be introduced to set up breeder farms to facilitate dairy animal breeding including cattle, buffaloes and goats and help improve the supply of breeding animals in the country.	From 2007 to 2020, the Ministry of Livestock Development, DAPH, and NLDB carried out various programs. DAPH focused on Artificial Insemination, semen production, herd improvement, and disease prevention initiatives.
4.	Promote milk consumption with accessible milk sales outlets in schools, hospitals, workplaces, etc.	Established milk sales outlets in schools, institutes, cities, and public places by Milco, NLDB, and private entities; enhances fresh milk consumption and income generation, requires further improvement.
5.	Organize dairy farmers into groups, empower decision-making, improve dairy production.	Empower dairy farmer management societies and cooperatives in milk production decisions; focus on production enhancements, fodder production, input supply, and collective market power.
6.	Support farmer associations and dairy processors to improve dairy product value chain efficiencies.	Dairy processors & farmer societies improve value chain with value-added products, outbound logistics. Increase farmer associations' involvement in production & processing for further enhancement.

Table 3 (Contd.):

Strategy	Current Situation
7. Use spearhead teams of trained officials to collaborate with provincial authorities, accelerate self-reliance in milk production.	This strategy has not been implemented.
8. Programs for technology transfer to improve dairy herd performance and farm productivity; introduce mechanization tools for medium to large-scale commercial dairy farming.	Strategy emphasizes mechanization for medium and large-scale dairy farms, NLDB employs modern milking, pasture & fodder machines, and irrigation, boosting milk production.
9. Support small-scale dairy operators through public sector programs for regular income assurance.	Government dairy development programs (e.g., Dairy Village, Heifer Calf, and Breeder Farm projects) by Ministry of Livestock Development and DAPH; Midterm evaluation shows 24% increase in milk production, positive economic impact.
10. Government prioritizes artificial insemination for genetic improvement of native herd; infeasible areas use superior bulls for selected genomes dissemination.	DAPH conducts Artificial Insemination and cattle/buffalo upgrading programs.
10. Establish national-level coordination for cattle and buffalo breeding to lead dairy breeding programs.	This strategy has not been implemented.
12. Setup National Animal Breeding Committee for guidance in breeding programs.	This strategy is not implemented
13. Regularly review milk production costs, dairy profitability, and tariff protection to enhance local industry competitiveness.	Livestock Policy Division and research institutions calculate milk production costs to set milk prices.
14. Attract dairy farmer equity in Milco (Pvt) Ltd. For greater benefits transfer.	Dairy farmer-managed societies in MILCO offer benefits, enhance inclusiveness.

Table 3 (Contd.):

Feed Resources Development Strategies	Current situation
15. Increase research funding for pasture and forages, improving ruminant feeding and local feed utilization.	There is a lack of emphasis on salinity-tolerant pasture and paddy field fodder production, although suitable fodder species are being distributed for different farming systems.
16. Introduce salt-tolerant pasture species, demonstrate cultural practices for utilizing saline and abandoned paddy lands for cattle, buffalo, and goat rearing.	No information found
17. Demonstrate pasture production in fallow paddy fields to extend grazing.	This strategy is not implemented
18. Introduce suitable pasture and fodder species, demonstrate their correct utilization with chaff cutters for higher roughage utilization in ruminant feeding.	Introducing suitable pasture species for different farming systems is taking place with the assistance of DAPH and NLDB
19. Harness rice polish, sugar cane tops, biogas, crop residues, and food processing plant residues as livestock feed resources.	Special concentrate feed popular in Northwestern province, lacks planned programs to enhance feed resources. Farmers use expensive supplementary feeds like rice polish, sugar cane tops, biogas, crop residues, and food processing plant residues.
20. Introduce haymaking and silage systems to enhance forage availability in dry periods.	Hay and silage making is practiced in NLDB farms.
21. Introduce and promote technologies for fibrous feed utilization, focusing on paddy straw utilization.	Implement strategy to promote paddy straw utilization, conserve natural resources.
22. Make state lands available to private sector for superior feed planting materials, demonstrate cultural practices, and engage in out-grower operations for animal feed ingredients.	NLDB farms are allocated for pasture, but common lands not used for this purpose.
23. Adopt supportive trade and tariff policy for domestic animal feed ingredient production.	These policies are imposed; however, farmers do not exploit these policy avenues.
24. Rectify tax incentives for BOI and non-BOI feed milling sectors	This needs to be investigated further.

The evaluation of dairy development strategies in Sri Lanka highlights a wide array of initiatives implemented by both government and private stakeholders to support small-scale dairy farmers, increase milk production, and strengthen the dairy value chain. One of the central strategies has been the support for small-scale farmers, focusing on improving existing production systems and promoting commercialization. While these efforts have had some impact, commercialization remains limited. Cost-sharing arrangements for village-level liquid milk processing have also been introduced with participation from farmer cooperatives and private entrepreneurs. This approach is relevant and cost-effective, promoting fresh milk over powdered alternatives, although persistent challenges in milk distribution infrastructure continue to constrain wider access.

To strengthen the breeding base, similar cost-sharing mechanisms have been applied to establish breeder farms for cattle, buffalo, and goats. From 2007 to 2020, institutions such as the Ministry of Livestock Development, DAPH, and NLDB implemented programs targeting artificial insemination, semen production, herd improvement, and disease prevention, contributing positively to the genetic quality of dairy animals. In parallel, milk sales outlets established by Milco, NLDB, and private companies in schools, hospitals, and public spaces have increased access to fresh milk and promoted consumption, although further expansion is needed.

Efforts to organize and empower dairy farmers through cooperatives and management societies have focused on enhancing production practices, input supply, fodder cultivation, and market access. Support for value chain development, particularly for dairy processors and farmer associations, has facilitated the production of value-added products and improved outbound logistics. Nevertheless, deeper involvement of farmer associations in processing and marketing is required to enhance competitiveness.

Several strategies, however, remain partially implemented or unaddressed. These include the deployment of specialized teams of trained officials to collaborate with provincial authorities, the establishment of a national coordination mechanism for breeding, and the formation of a National Animal Breeding Committee. Technology transfer and mechanization strategies have been adopted mainly in medium- and large-scale farms

managed by NLDB. While these interventions have demonstrated productivity gains, small-scale farmers have yet to benefit substantially from modern tools and practices.

Government programs targeting small-scale dairy producers such as the Dairy Village, Heifer Calf, and Breeder Farm projects have yielded encouraging results. Midterm evaluations reported a 24% increase in milk production and overall positive economic impact. The government has also prioritized artificial insemination and the use of superior bulls for genetic improvement in regions where AI is not feasible. Institutions regularly review production costs and profitability to determine competitive milk prices. Additionally, dairy farmer-managed societies in MILCO enhance benefit-sharing and inclusiveness.

Sustainability strategies include promoting integrated farming systems and adopting compost and biogas technologies. Many conventional farmers use compost as fertilizer and receive biogas units from government and NGO programs, contributing to household energy needs and environmental sustainability. In terms of feed resource development, the government has increased research funding for pastures and forages, introduced suitable fodder species, and promoted efficient roughage utilization. However, policy support for salinity-tolerant pastures or utilization of abandoned lands remains limited, although DAPH and NLDB have introduced suitable species in select areas. Demonstrations of pasture production in fallow paddy fields and proper use with chaff cutters are ongoing but not yet widespread.

Farmers, particularly in the Northwestern Province, make use of alternative feed resources such as rice polish, sugarcane tops, biogas residue, crop residues, and food processing by-products. However, there is a lack of structured programs to promote and regulate these practices. Hay and silage production are mainly practiced in NLDB-managed farms, while strategies to utilize paddy straw focus on conserving natural resources. Although NLDB has allocated farmlands for pasture development, common lands remain largely underutilized. Strategies to make state lands available for superior feed production and out-grower engagement have yet to be widely adopted. Trade and tariff policies exist to support domestic feed

production, but most farmers are unaware of or unable to access these incentives. Tax incentives for BOI and non-BOI feed milling sectors exist, yet their impact on competitiveness requires further evaluation.

In conclusion, Sri Lanka has made considerable progress in developing its dairy sector through targeted strategies in breeding, fresh milk marketing, and farmer empowerment. Nevertheless, gaps remain in coordination, feed resource development, and mechanization for smallholders. Strengthening the sector will require accelerated implementation of unaddressed strategies, enhanced farmer awareness and access to existing policies, and expanded inclusive approaches to improve production, marketing, and resource sustainability.

4. Conclusions and Recommendations

The 2006 National Dairy Policy of Sri Lanka was formulated with the objective of achieving sustainable economic and social development through increased domestic milk production. A key target of the policy was to attain 50% self-sufficiency in milk by 2015. To achieve this, the policy adopted a multifaceted approach that emphasized the genetic improvement of local cattle herds, the transformation of subsistence-level dairy farms into commercially viable enterprises, the regulation of dairy imports, and the promotion of medium- and large-scale dairy operations. Furthermore, it prioritized the empowerment of dairy farmers through institutional support mechanisms and the provision of technical assistance. To achieve these objectives, a range of national-level programs was implemented, with a particular focus on supporting small-scale dairy farmers. Key initiatives included the establishment of breeder farms and the importation of high-yielding exotic animals to enhance the genetic potential of local dairy herds. Artificial insemination (AI) was recognized as a critical tool for genetic improvement; however, its effectiveness has been constrained by challenges such as substandard semen quality, inadequate heat detection, and limited technical expertise at the field level.

Simultaneously, efforts were made to improve the availability and quality of feed resources, acknowledging that nutrition is a fundamental determinant of animal productivity, reproductive performance, and overall health.

Despite these interventions, the dairy sector continues to experience notable gaps in production efficiency. Constraints persist in feeding practices, breeding management, and the adoption of modern technologies, highlighting the need for more comprehensive and coordinated strategies to optimize productivity and sustainability in the national dairy herd.

Looking ahead, several strategic interventions are essential to strengthen Sri Lanka's dairy sector. Key measures include improving on-farm management practices through efficient feeding systems, enhanced animal health care, and climate-resilient housing. Strengthening artificial insemination (AI) services by ensuring access to high-quality semen, timely heat detection, and skilled technical support is also crucial. Additionally, building the capacity of dairy farmers through regular training in modern dairy technologies, financial management, and record-keeping will enable informed decision-making and improved farm-level productivity.

Promoting public-private partnerships is vital to expand infrastructure investment, particularly in milk processing, storage, and value addition. The adoption of modern technologies—such as automated milking systems, digital herd-monitoring tools, and mobile-based advisory services—can further optimize efficiency, enhance product quality, and increase profitability across the dairy value chain. By integrating technology with capacity building and market support, the sector can achieve greater resilience and competitiveness.

In conclusion, while the 2006 National Dairy Policy provided a solid foundation and contributed to measurable progress, long-term sustainability and competitiveness require renewed policy attention. A forward-looking approach that emphasizes efficiency, innovation, and inclusive growth is essential to unlock the full potential of Sri Lanka's dairy industry, enhance rural livelihoods, and strengthen national food security.

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