# A SUPPLIER DEVELOPMENT FRAMEWORK FOR AGRI-FOOD VALUE CHAINS IN DEVELOPING COUNTRIES: A TEST ON A DAIRY VALUE CHAIN IN SRI LANKA

A thesis with publication presented in partial fulfilment of the requirement for the degree of

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New Zealand.

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**Declaration**

I, Leeza De Silva (Student ID:            ), declare that this thesis entitled “A supplier development framework for agrifood value chains in developing counties: a test on a dairy value chain in Sri Lanka” submitted to Massey University for the degree of Doctor of Philosophy is the outcome of my own research work. This thesis was produced according to Massey University’s PhD thesis by publication requirements. It is based on research that is published, is in revision following reviewers’ comments, or is in preparation to be submitted. Consequently, the submitted chapters are relatively succinct, there is some repetition (particularly in literature review and methodology), and there may be minor stylistic differences between chapters. I also certify that the thesis has not been presented, in whole or partly, for any degree or diploma.

## Abstract

Agri-food value chains (AVC) in developing countries, including dairy value chains (VC), face significant challenges. A key issue is farmers' limited capacity to improve their operational performance (e.g., product quality, delivery, and production efficiency) despite the support they may typically receive, which hinders the achievement of their triple-bottom-line (TBL) outcomes. In an AVC, farmers supply commodities that buyers (e.g., processors) purchase to add value. The concept of *supplier development* (SD) refers to a buyer taking an effort—strong or weak—to improve the capability and/or performance of their supplier. This makes SD (as understood in operations and supply chain management), an attractive proposition for predicting and explaining how farmer development initiatives by buyers can improve farmers' operational performance and their TBL outcomes. The objectives of the study were to: (i) study the dairy VC of Sri Lanka to understand how farmer development takes place through a milk processor; (ii) develop and test a theoretical model that predicts and explains the relationship between processor-led farmer development initiatives, farmer capability, processor-farmer relationship, and a farmer's sustainable performance; (iii) analyze farmer heterogeneity to enable milk processors and other interested parties to better focus on farmer development initiatives; (iv) develop an index to measure the overall sustainable performance of dairy farmers and facilitate efficient, sustainability-focused development.

The model developed through the literature posited that farmer development—farmer training (FT), financial support (FS), evaluation and feedback on farmer quality performance (EFFQP)—results in farmer TBL performance, through the mediation effects of farmer capability (FC) and processor-farmer relationship (PFR). Data collected from 324 Sri Lankan dairy farmers were analyzed using partial least squares structural equation modeling (PLS-SEM). The heterogeneity analysis was conducted using cluster analysis, while the parameters of the sustainability index were estimated by fitting an index-creating model to the data.

The findings supported the overarching hypothesis. FS as well as EFFQP were found to be having a more substantial positive impact on sustainable farmer performance than FT. Cluster analysis identified three distinct clusters—labeled as laggers, accelerators, and leaders—based on the cluster variables used. Laggers were found to be significantly underachieving in economic outcomes and FC, compared to accelerators. Notable differences in farmer and farm characteristics were identified across these clusters, and cluster-specific suggestions were provided to milk processors and policymakers to improve the FC and TBL outcomes of the farmers. The overall sustainability index, which considered farmer TBL outcomes and their enablers, suggested that all components and sub-components of the index are important (weight-wise) but farmer capability as a category commanded the highest weight (0.236) and farmer's economic outcomes as a category commanded the lowest weights (0.170). The implications of these empirically generated weights were discussed and how the study contributes to new knowledge was argued.

**Keywords:** Agri-food value chain, Dairy, Developing countries, Farmer development, Sri Lanka, Supplier development

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A PhD is more than an academic pursuit; it is a journey of resilience, curiosity, and transformation. It demands intellect, perseverance, self-belief, and the support of a strong community. This thesis is a testament to the collective efforts, guidance, and encouragement I have been fortunate to receive, transforming what once seemed impossible into a reality.

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# TABLE OF CONTENTS

## LIST OF TABLES

## LIST OF FIGURES

## LIST OF ABBREVIATIONS

| | |
|---|---|
| AVC | Agri-food value chain |
| BOP | Base of pyramid |
| BP | Buyer performance |
| CBSEM | Covariance-based structural equation modeling |
| CSCC | Cooperative Society collecting centers |
| CSR | Corporate social responsibility |
| DAPH | Department of Animal Production and Health |
| EFFQP | Evaluation and feedback on farmer quality performance |
| EnvS | Environmental sustainability |
| ES | Economic sustainability |
| FAO | Food and Agriculture Organization |
| FC | Farmer capability |
| FD | Farmer development |
| FMSC | Farmer-managed society centers |
| FS | Financial support |
| FT | Farmer training |
| GDP | Groos domestic production |
| GNI | Gross national income |
| GPS | Global positioning system |
| GRI | Global Reporting Initiative |
| HACCP | Hazard analysis and critical control point |
| IST | Instrumental stakeholder theory |
| KPI | Key performance indicator |
| NGO | Non-Governmental Organizations |
| NLDB | National Livestock Development Board |
| PFR | Processor farmer relationship |
| PLS-SEM | Partial least squares structural equation modeling |
| PM | Performance measurement |

| | |
|---|---|
| RA | Research Assistant |
| RBV | Resourced-based view |
| SASB | Sustainability Accounting Standards Board |
| SC | Supply chain |
| SCM | Supply chain management |
| SD | Supplier development |
| S-D logic | Service-dominant logic |
| SDG | Sustainable development goals |
| SEM | Structural equation modeling |
| SET | Social exchange theory |
| SLCARP | Sri Lanka Council for Agricultural Research Policy |
| SNF | Solids-not-fat |
| SP | Supplier performance |
| SS | Social sustainability |
| SSD | Sustainable supplier development |
| ST | Stakeholder theory |
| TCFD | Task Force on Climate-related Financial Disclosures |
| TBL | Triple bottom line |
| TQM | Total quality management |
| UHT | Ultra high temperature |
| UN | United Nations |
| VC | Value chain |

# CHAPTER 1: INTRODUCTION

This chapter introduces the topic (Section 1.1), the study context (Section 1.2), the motives of the study (Section 1.3), the aim and objectives of the study (Section 1.4), the research questions that have been posed to achieve the study objectives (Section 1.5), the novelty of the study (Section 1.6), an overview of the methods employed (Section 1.7), the ethical considerations (Section 1.8), and an outline of the thesis structure (Section 1.9).

## 1.1 Introduction of the topic

This section introduces the key topics of the study: supplier development, sustainable supplier development, and agri-food value chains in developing countries.

*Supplier development* (SD) is a well-established concept in operations management, where a purchasing firm would actively engage with their core suppliers in enhancing the value creation capability of the latter; this is for the purchasing company to gain a competitive advantage through superior performance (Krause et al., 2007; Wagner, 2009). Much of the theory development on SD emerged in the manufacturing industry during the quality era (1980–2000)—also referred to as the total quality era (Hackman & Wageman, 1995; Summers, 2018)—shaped by quality advocates such as W. Edwards Deming (1900-1993). One of the key points Deming emphasized in his famous 14 points on quality management, is limiting the number of core suppliers—single supplier for the supply of a specific component—and working with them to foster long-term relationships to achieve manufacturing excellence, through superior quality (Anderson et al., 1994; Summers, 2018). Deming's fourth point has it all: "End the practice of awarding business on the basis of price tag alone. Instead, minimize total cost. Move toward a single supplier for any one item, on a long-term relationship of loyalty and trust" (Deming, 1986, p. 23). The widely used definition of SD introduced during the quality era is: "Any effort of a firm to increase performance and/or capabilities to meet the firm's short and/or long-term supply needs" (Krause, 1997, p. 12); this definition has evolved since, to cover supply chain (SC) sustainability. Hence SD with a focus on sustainability has been defined as *sustainable supplier development* (SSD) (Bai & Satir, 2022; Jia et al, 2023).

The three pillars of sustainability—economic sustainability, social sustainability, and environmental sustainability—are theoretically represented by the triple bottom line (TBL) framework (Elkington, 1998) which has become synonymous with the concept of sustainability. Originally developed in the field of corporate accounting, but the TBL framework emphasizes the importance of businesses looking beyond pure profit motives (the 'bottom line') to achieve long-term success (Elkington, 1998; Elkington & Rowlands, 1999; Gray et al., 1995; Raimo et al., 2022). Since SCs consist of interconnected and interdependent businesses aimed at delivering customer value—often driven by a lead firm—it is not surprising that the TBL framework became an essential conceptualization in research related to sustainable SCs and SSD (Carter & Rogers, 2008; Rajeev et al., 2017; Seuring & Müller, 2008).

Bai and Satir (2022, p. 1) defined SSD as "any initiative taken by the buying firm to improve their supplier sustainability capabilities to meet two or more elements of the triple bottom line (TBL) of multiple stakeholders along the supply chain (suppliers, buying firms, customers, etc.)". Given this definition, it can be argued via *instrumental* stakeholder theory (ST) (Donaldson & Preston, 1995; Jones et al., 2018; Valentinov & Hajdu, 2021) that any SSD which focuses only on social and environmental perspectives, remains highly questionable because suppliers and other stakeholders as business entities would hardly appreciate gains on these two sustainability pillars/dimensions unless they gain long-term benefits to their bottom line (Carter & Rogers, 2008). If it is not possible to improve all three dimensions of sustainability simultaneously, either combination of improvements that include the economic dimension—economic and social or economic and environmental—achieved through SSD would still be valued by suppliers and other stakeholders in the SC (Jia et al., 2018; Jia et al., 2023).

Although manufacturing excellence practices including SD have now been widely used outside the traditional manufacturing domain, applying SD concepts such as reducing the supplier base to a minimum (let alone a single supplier) presents distinct challenges in an agri-food SC—more formally known as an AVC—due to capacity and other issues inherent in agriculture (Gómez & Lee, 2023; Yuan et al., 2024). However, conceptually, SD concepts, such as building trust and long-term relationships with the suppliers and limiting the supplier base to suppliers who meet quality standards and other purchase requirements, are still applicable to AVCs (Gómez & Lee, 2023; Mukucha & Chari, 2021; Yuan et al., 2024). Consequently, buyers of primary produce, such as processors, must implement SD programs and maintain strong working relationships with many suppliers, supplying the same commodity, to meet the buyer's capacity needs. This can be highly challenging, as it may involve managing relationships with thousands of suppliers (Pappa et al., 2019). Hence the phrase *processor-led farmer development*—a phrase coined by the researcher—or more generally, buyer-initiated farmer development[1] can be considered a natural extension of the concept SD when applied to AVCs (Brix-Asala et al., 2021; De Silva et al., 2023; Mukucha & Chari, 2021). Since the definitions of SD (Krause, 1997) or SSD (Bai & Satir, 2022) mentioned earlier are broad, they are being extended to the present research. The growth of the literature on "*sustainable farmer development"* is depicted in Figure 1.1.[2] Of course, not all hits on sustainable farmer development shown in Figure 1.1 will involve the processor as the buyer providing farmer development.

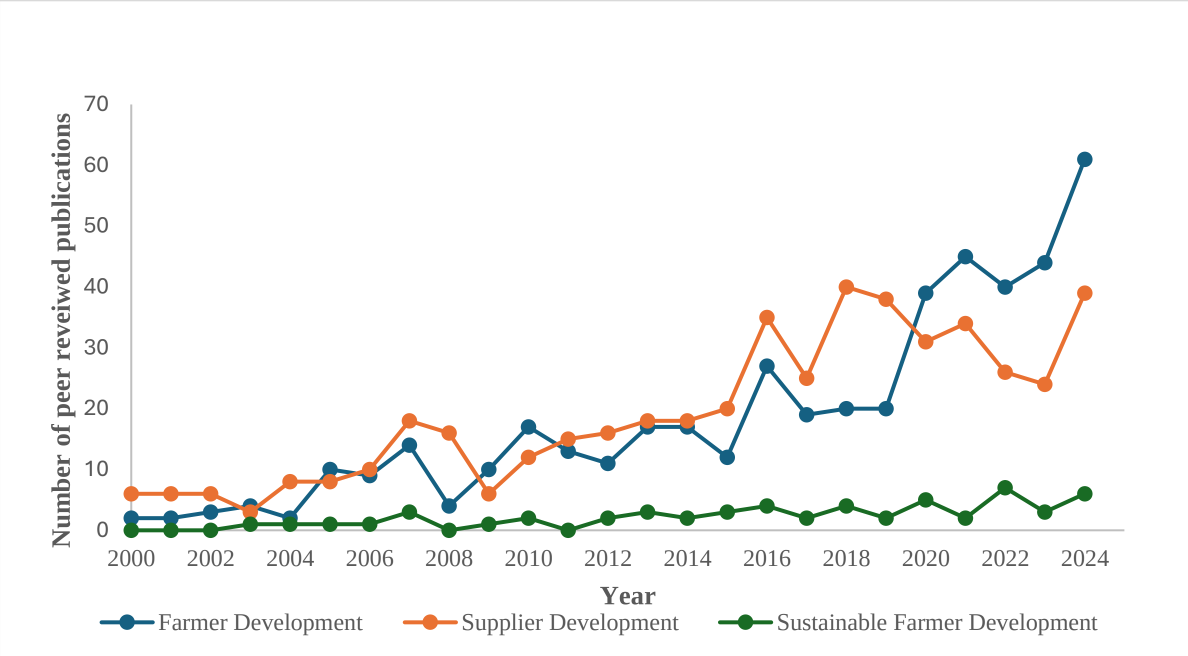


**Figure 1.1 Proliferation of the terms SD, farmer development, and sustainable farmer development in articles published since the year 2000**
*(Source: Own work)*

In *AVCs in developing countries*, processor-led farmer development becomes particularly important because most primary sector producers are small-scale operators. These producers often lack economies of scale, technical expertise, and access to modern technologies, unlike their counterparts in developed countries (De Silva et al., 2023; Khairallah et al., 2023; Trienekens, 2011). How can a food processing company, acting as a buyer, enhance the value-

1 In some contexts. The buyers of farm produce need not necessarily be processors; vendors can purchase produce from farmers in bulk (e.g., in the tobacco industry) and sell to processors and other companies that need the commodity for their production or consumption.

2 Figure 1.1 was generated via SOCUS, using multiple keyword combinations joined through the Boolean operators 'OR' and 'AND' to generate the citation counts for 'farmer development' and 'sustainable farmer development'. For example, for 'farmer development', the Boolean operator OR was used as follows: "farmer development" OR "farmer training" OR "farmer capacity building"

creation capabilities of thousands of small-scale primary sector producers[3] (the focus of this research is on farmers) supplying the same commodity to the company? What farmer development activities are currently taking place in a developing country context? How do these activities improve farmers' value-creation capabilities? To what extent do these outcomes enhance farmers' economic, social, and environmental performance? *These are some of the pragmatic questions this research aims to answer* (research questions in section 1.5). Answering these questions has become more important in the 21st century, with the rise of sustainability concerns, the United Nations (UN) Sustainable Development Goals (SDGs), and globalization[4].

In operations and supply chain management (SCM) literature, it has been argued that SD to improve supplier performance would take place through the buyer's direct initiatives (e.g., training, financial and technological investment, knowledge transfer) and indirect initiatives (e.g. higher volume purchase, promising longer-term supply contracts, supplier certification) which also benefits the buyer in sustaining its competitive position (Benton et al., 2020; Gosling et al., 2016; Yawar & Seuring, 2020).

The causal link between the SD initiatives (direct or indirect) and *supplier performance* is sometimes hypothesized as direct and occasionally indirect—for example, being mediated by the buyer-supplier relationship—depending on the theoretical lens being used in posting the relations (e.g., Benton et al., 2020; Velayutham et al., 2021). More complex mediation paths between SD initiatives and supplier preference have also been posited (e.g., Wagner, 2009; Yawar & Seuring, 2020). Supplier performance is generally being operationalized as a concept reflecting *product quality and delivery performance*, plus author-chosen indicators such as price, responsiveness to changes in the supply conditions, and supplier service quality to suit the context (Benton et al., 2020; Wagner, 2009; Yawar & Seuring, 2020).

Theorizations of buyer initiated farmer development in developing countries are basic—a shortcoming addressed through this by research—but sufficient evidence has been provided in the literature (e.g., Brix-Asala et al., 2021; Mukucha & Chari, 2021; Yawar & Kauppi, 2018)

[3] The primary sector not only covers agriculture, forestry, horticulture, and seafood/fishing, but also activities such as mining, quarrying, and a few others Central Bank of Sri Lanka. (2023). *Annual Economic Review*. https://www.cbsl.gov.lk/sites/default/files/cbslweb_documents/publications/aer/2023/en/Full_Text.pdf.

[4] SDGs are covered in the next chapter.

to demonstrate a causal connection between buyer-initiated farmer development (cause) and farmer performance (effect) in terms of farmers' improved delivery performance, quality performance, and other buyer-desired supplier performance attributes. This multidisciplinary study expands the current body of knowledge on buyer-initiated farmer development in a developing country from a SC perspective. It provides a comprehensive understanding of farmer development initiatives, the farmer performance attributes desired by buyers (the milk processors), the nature of the relationships between the buyer and its farmers, and, above all, how these concepts impact a farmer's TBL performance.

## 1.2 Introduction of the study context

### 1.2.1 The economy of Sri Lanka by sector

The Democratic Socialist Republic of Sri Lanka is an island, with approximately 66,000 km$^2$ of land area in the Indian Ocean, bordered by India to the Northwest and the Maldives to the Southwest. Of the 21 million people living in Sri Lanka, approximately 81% live in rural areas.[5] Administratively, Sri Lanka has nine provinces, 25 districts, 331 divisions, and 14,022 villages. In the year 2023, the country had a total gross domestic product (GDP) of US$ 84.4 billion and a gross national income (GNI) per capita of US$ 3,706 (Central Bank of Sri Lanka, 2023). In 2023, the agriculture contributed approximately 8.3% to Sri Lanka's GDP, reflecting a slight decline from 8.5% in 2022.

The structure of the Sri Lankan economy is changing with a long-term decline in the agriculture sector's contribution to GDP in favor of a substantial increase in the service sector's contribution towards the GDP, as shown in Figure 1.2. In real terms also, the agriculture sector has declined, given the fact that the US$ 1.6 billion GDP adjusted to 2023 value is about US$ 23 billion. Having moved to a middle-income country[6] in 1997, Sri Lanka lost a considerable amount of developmental aid it used to received previously from donor agencies.

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[5] Source: https://www.ifad.org/en/w/countries/sri-lanka

[6] According to the World Bank (their 2024 definition), a middle-income country is a country whose GNI ranges from US$1,136 to US$13,845.

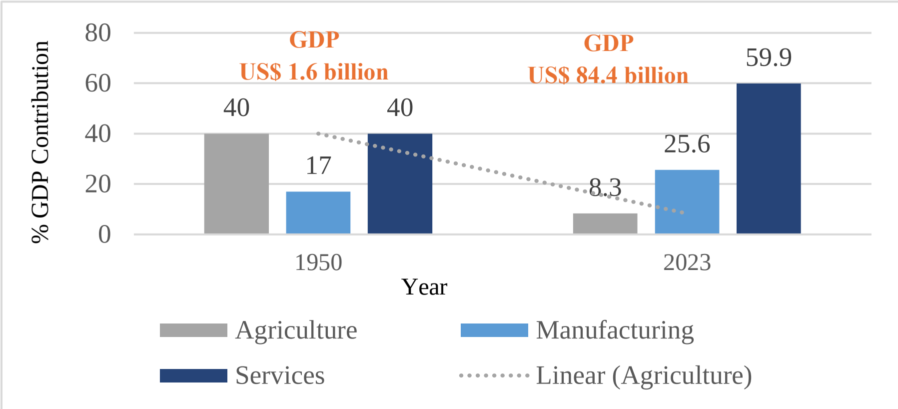


**Figure 1.2 Contribution of main economic sectors to the GDP of Sri Lanka in 1950 and 2023**
*(Source: Department of Census and Statistics, 2024)*

Sri Lanka has a long-standing history of its agriculture industry. Initially agriculture activities were limited to domestic consumption and, however later during the British colonial era (1796–1948), Sri Lanka underwent a remarkable change in the agriculture industry, when commercial crops such as tea, coffee, rubber, and coconut were introduced for mass production. As a result, consumption-based agriculture transformed into a trade-based SC spanning the globe. Later, in 1977, the economy was opened for free trade beyond the national boundaries, but this change did not bring the desired increase in GDP contribution from the agriculture sector.[7] However, the agriculture sector is still important to the Sri Lankan economy (Department of National Planning, 2019) as it provides food security (for local consumption and exports) and employment opportunities to people. Approximately 26.1% (Central Bank of Sri Lanka, 2023) of the total employed population is engaged in agriculture, inclusive of forestry and fishery (Department of National Planning, 2019). Further, agriculture is the mainstay of the rural sector (Craighead et al., 2016) of Sri Lanka, where most of the population (77.4%) lives (Central Bank of Sri Lanka, 2019). The majority of those who live below the poverty line reside in the rural and estate sectors where dairy farming is practiced (Marambe et al., 2017). Hence paying attention to agriculture, including dairy farming, is important as it remains an important income-generation activity in rural livelihoods (Department of National Planning, 2019). Sri Lankan agriculture industry consists of 17 subcomponents as shown in Figure 1.3.

[7] As a result of free trade, the manufacturing sector grew thanks to the establishment of export-oriented apparel manufacturing, and the country is still well-known for high quality apparel contract manufacturing for leading global brands.

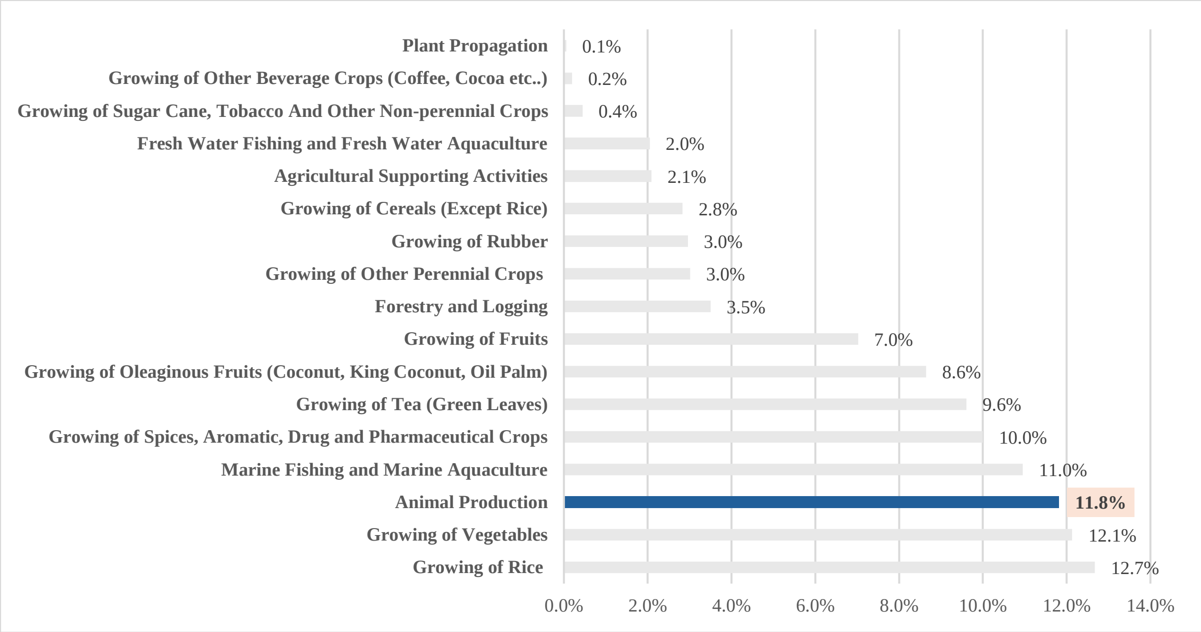


**Figure 1.3 Agriculture sector subcomponent percentage contribution to GNI 2023**
*(Source: Department of Census and Statistics, 2024)*

### 1.2.2 Animal production and dairy farming in Sri Lanka

The animal production subcomponent consists of dairy farming, poultry, and other farming such as the rearing of cattle, goats, and pigs (Achchuthan & Rajendran, 2012). Within the animal production subcomponent, the study will further delve into the dairy sector. Dairy farming has been an integral part of agriculture in Sri Lanka since 400 BC. Rearing a large herd of cattle was perceived be an icon of wealth. However, this self-sufficient industry was disrupted by foreign powers that invaded and ruled the country (Vidanarachchi et al., 2019). Before the adoption of open economic policies in 1977, local milk production had been fulfilling 80% of the local consumption needs, whereas, at present, the industry meets only about 40% of the domestic consumption requirement of milk. The balance is imported (Vidanarachchi et al., 2019) as depicted in the Figure 1.4.

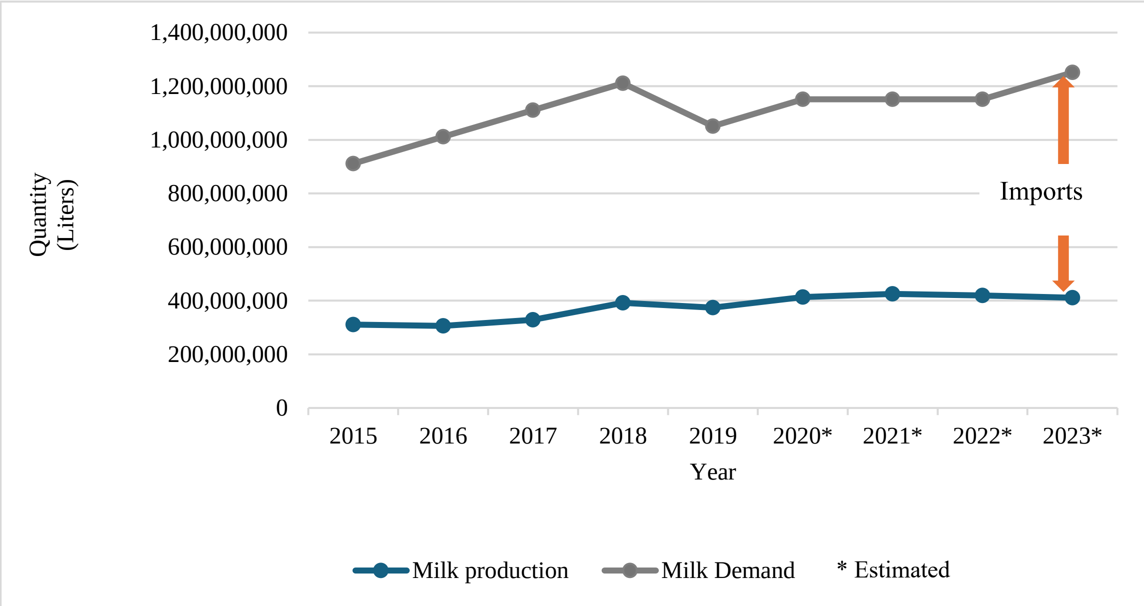


**Figure 1.4 Milk production, demand, and imports in Sri Lanka (2015-2023)**
*(Source: Department of Census and Statistics, 2024)*

As shown in Figure 1.4, about 60% of annual local demand is imported in the form of milk (mostly in powdered form) and milk-based products consisting of condensed milk, cheese, curd, butter, buttermilk, curdled milk, whey, and whey powder (Department of Animal Production and Health, 2023). The import of milk and milk-based products shows an increasing trend due to insufficient domestic production and higher demand (Hitihamu, 2022; Vidanarachchi et al., 2019).

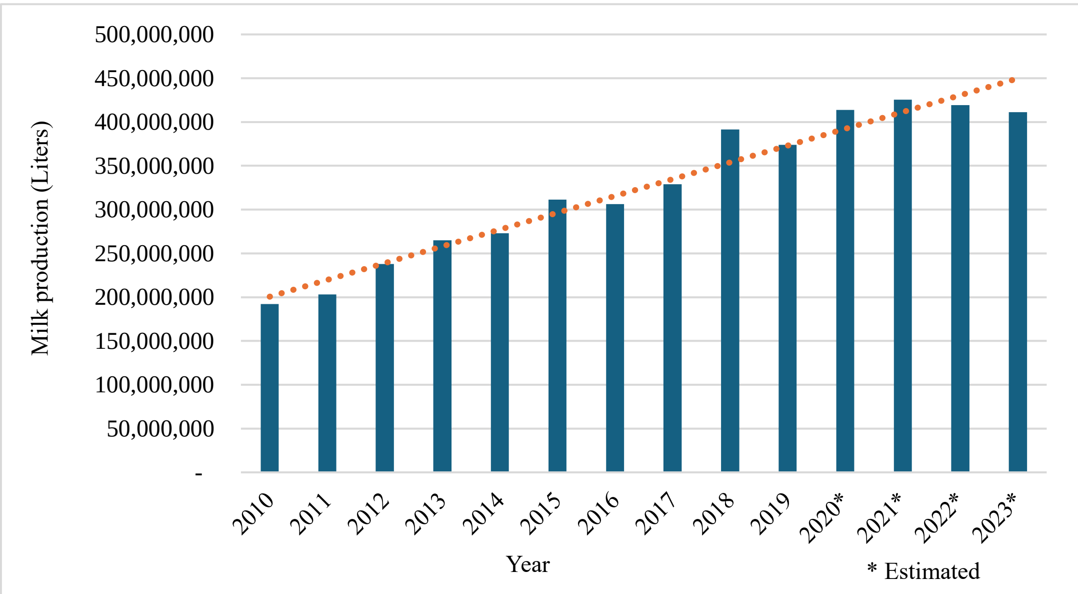


**Figure 1.5 Milk production trend in Sri Lanka (2010- 2023)**
*(Source: Department of Census and Statistics, 2024)*

Overall, as shown in Figure 1.5, dairy production in Sri Lanka[8] has shown a general upward trend over the years, although there have been fluctuations. Based on the estimated figures for the 2020-2023 period, it seems that, after reaching its peak in 2021, production has leveled off in 2022 and 2023. The related industries have reasoned the decline in 2022 may be due to feed shortages and climate impact. However, it is also reasoned that the decline in 2023 may be due to the transitional phrase of the industry where smallholder farmers are gradually shifting towards larger and more efficient production systems (Ministry of Industries, 2023). Despite the several strategic measures that have been taken to improve dairy production in Sri Lanka, such as genetic improvement, exotic breed importation, institutional support, and dairy processing expansion, these efforts remain insufficient. This underscores the need for more comprehensive and targeted interventions (Hitihamu, 2022; Vidanarachchi et al., 2019).

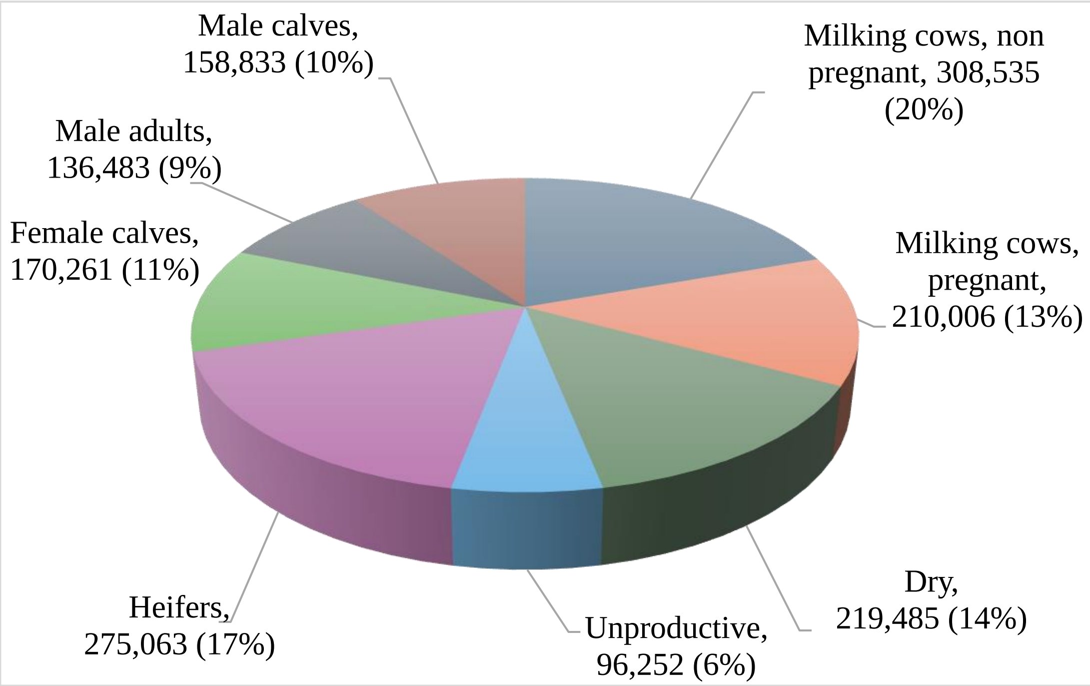


**Figure 1.6 The classification of cattle based on 2023 livestock census**
*(Source: Department of Animal Production and Health, 2023)*

Based on livestock census in 2023, the total domesticated cattle population in the country, was 1,574,918 (Department of Animal Production and Health, 2023) (See Chapter 1, Appendix 1 for more details). Figure 1.6 shows the composition of this number. It is important to note that these figures do not show the number of buffalos being used for dairy and other agricultural activities (mainly for paddy cultivation). Although the buffalo population of the country is low, in a few districts (e.g. Hambantota and Batticaloa), the numbers are become comparable with

[8] Mainly cow's milk, but in a few districts (e.g. Hambantota and Batticaloa) Buffalo milk is also prominent.

those of the cows. In 2023, the highest number of cattle populations were recorded in Batticaloa (322,104), Anuradhapura (148,179), and Kurunegala, (117,069) districts. Unsurprisingly, dairy farming and cattle breeding have been confined to the rural areas of the country (Department of Animal Production and Health, 2023).

Table 1.1 depicts the number of farm businesses[9] in each district of Sri Lanka, based on the size of the farms. In farm size classification, the Department of Census and Statistics (2024), the country's statistics gatekeeper, considers a farm having <10 cows as a smallholder farm business, 10-50 cows as a medium farm business, and >50 cows as a large farm business, which is consistent with what is used in literature (Opio, 2017; Vidanarachchi et al., 2019). Table 1.1 also highlights the two districts that were selected for the study: Nuwara Eliya and Kurunegala. These are two of the highest cow milk production districts in Sri Lanka.

Due to climatic conditions favorable for breeding Australian and New Zealand-origin high milk-yielding cows—Jersey and Holstein Friesian—and their hybrids, farms in the Nuwara Eliya district (this district is in the upcountry with altitudes around the 2000m mark) return the highest average production per cow (≥6.0L/cow/day), whereas the districts in the intermediate zone return 3.0-4.0L/cow/day (e.g. Kurunegala district), and still worse, the districts in the dry zone returns only 2.1L/cow/day (Ranaweera, 2008; Vidanarachchi et al., 2019). The milk productivity gap between the Nuwara Eliya average and the New Zealand average is substantial: 6L/cow/day (Nuwara Eliya) versus 14L/cow/day (New Zealand) (Dairy NZ Limited and Livestock Improvement Corporation, 2023; Department of Animal Production and Health, 2023). Note that the Sri Lankan estimates are conservative, and the figures may have been derived using lactating and non-lactating cows for the denominator.

[9] The publisher of the data, the Department of Census and Statistics, Sri Lanka lists the data under the heading 'Number of Dairy Farmers by farm size - 2023'. This heading is misleading because at least some medium size farms and all large farms require farm workers and other staff to run the business. This is the reason why the researcher used the term 'farm business' instead of the term 'farmer' used by the publisher.

**Table 1.1 Number for dairy farm businesses by size (dairy cows) and by district**
*(Source: Department of Census and Statistics, 2024)*[10]

| Province | District | < 10 cows | 10-50 cows | > 50 cows | Total |
|---|---|---|---|---|---|
| Western | Colombo | 1,006 | 207 | 36 | 1,249 |
| | Gampaha | 4,338 | 180 | 169 | 4,687 |
| | Kalutara | 1,723 | 67 | 0 | 1,790 |
| Central | Kandy | 4,807 | 44 | 8 | 4,859 |
| | Matale | 3,038 | 152 | 10 | 3,200 |
| | Nuwara-Eliya ✓ | 5,728 | 280 | 32 | 6,040 |
| Southern | Galle | 1,709 | 54 | 51 | 1,814 |
| | Matara | 1,470 | 35 | 19 | 1,524 |
| | Hambantota | 1,548 | 413 | 51 | 2,012 |
| Northen | Jaffna | 9,351 | 368 | 31 | 9,750 |
| | Mannar | 2,595 | 757 | 209 | 3,561 |
| | Vavuniya | 2,916 | 1,367 | 227 | 4,510 |
| | Mullativu | 3,069 | 395 | 17 | 3,481 |
| | Kilinochchi | 3,959 | 458 | 1 | 4,418 |
| Eastern | Batticaloa | 4,156 | 1,127 | 545 | 5,828 |
| | Ampara | 5,055 | 1,769 | 412 | 7,236 |
| | Trincomalee | 3,294 | 543 | 57 | 3,894 |
| Northw estern | Kurunegala ✓ | 14,217 | 1,478 | 233 | 15,928 |
| | Puttalam | 4,631 | 447 | 27 | 5,105 |
| North Central | Anuradhapura | 10,304 | 2,592 | 273 | 13,169 |
| | Polonnaruwa | 4,433 | 419 | 58 | 4,910 |
| Uva | Badulla | 6,939 | 90 | 300 | 7,329 |
| | Moneragala | 3,071 | 324 | 6 | 3,401 |
| Sabara gamu | Ratnapura | 1,642 | 127 | 29 | 1,798 |
| | Kegalle | 1,287 | 194 | 1 | 1,482 |
| **Total** | | **106,286** | **13,887** | **2,802** | **122,975** |

**The Map of Sri Lanka**


✓ The two districts selected for the study

*The researcher's four research assistants were based in the Kandy district, being final year honours students affiliated with the University of Peradeniya, Kandy, Sri Lanka*

[10] The map of Sri Lanka was copied from the following URL: https://www.mappr.co/counties/sri-lanka/

In the dairy sector, three types of farming systems are being referred to: intensive farming, semi-intensive farming, and extensive farming (Salas et al., 2021). In an intensive dairy farming system, farmers maximize production per unit of land by using high levels of inputs such as feed, veterinary care, technology, and labor. The focus is on high milk yield and often involves keeping dairy cows in confined spaces, such as barns or sheds. Conversely, extensive dairy systems are characterized by low levels of inputs and labor. Cows are usually grazed on large areas of land with little supplemental feeding or care, relying primarily on natural pasture and the local environment for nutrition. The semi-intensive is between intensive and extensive system (Premaratne et al., 2019; Vidanarachchi et al., 2019). The proportions of intensive, extensive, and semi-intensive farming systems in Sri Lanka, dairy farming, are estimated to be 15%, 34%, and 51% respectively (Vidanarachchi et al., 2019). The type of the farming system depends on factors such as agroecological zone, number of animals, land and capital availability, types of breeds and the productivity of animals, roughage feed source and supply, etc. (Vidanarachchi et al., 2019).

### 1.2.3 The dairy VC of Sri Lanka

#### *1.2.3.1 The formal and informal sector*

The primary activities/processes in the dairy VC include milk production, collection, processing, distribution, and retail. In the scale of operations, farm businesses can be classified as small, medium, and large. Milk processors (through their own collecting centers) and intermediaries such as farmer-managed society centers (FMSCs), cooperative society collecting centers (CSCCs), and other private collectors who collect milk from the farmers. Once the milk has been collected it is transported to the milk processor for processing. After the processing stage, the products (e.g., skimmed milk, semi-skimmed milk, milk powder, yogurt, ice cream, curd, ghee, pasteurized milk, UHT milk, butter, sterilized milk, flavored milk, butter, oil, etc.) are transferred to the distributors and retailers or to the milk processor's own sales outlets. It is also noted that as is the case in many developing countries, the milk market of Sri Lanka comprises an informal market as well as the formal market. Based on 2023 data, it has been estimated that 70%-80% of raw milk harvested on dairy farms enters the formal channel involving milk processors (Korale-Gedara et al., 2023); while milk that enters the informal market rarely ends up as value-added products as it is sold to neighboring consumers and hotels for consumption.

Currently, there are about 21 major milk processors in Sri Lanka who purchase/collect milk and add value to it through the creation of different product offerings. Some of the main milk processors are Milco (Pvt) Limited, Nestlé Lanka, Lanka Milk Foods (CWC) PLC, Cargills Ceylon PLC, and Pelwatte Dairy Industries Limited. A salient operational feature in the Sri Lankan context is that all major dairy processors in the country operate 'under capacity' because the anticipated growth in the supply side (farm production) for which the milk plants have been designed has not eventuated (Vidanarachchi et al., 2019).

Ministry of Agriculture, Department of Animal Production and Health (DAPH), National Livestock Development Board (NLDB), Department of National Planning, Mahaweli Livestock Enterprises Ltd., Sri Lanka Council for Agricultural Research Policy (SLCARP), Veterinary Research Institute and the provincial departments of the NLDB are the main government bodies that govern and support the dairy sector in Sri Lanka. These institutions are meant to collectively address challenges such as food safety, quality control, and market access, within a system of *policy frameworks.* The relevant policies are: The National Dairy Policy (2023), the National Dairy Development Policy (2006), the National Livestock Breeding Policy (2010), and Overarching Agriculture Policy (2019).

In addition to policy formulation, the government also seeks support from international organizations and non-governmental organizations (NGOs) to implement various projects aimed at developing dairy farming. Notable projects are shown in Chapter 1, Appendix 2. A few privately owned milk processors (most certainly the ones involved in this study) are also engaged in farmer development in a selective capacity. However, researchers and evaluators of past farmer development projects have recommended better strategy and policy formulation, improved planning and implementation of strategies, and the establishment of an effective monitoring process to address the current underperformance of the country's dairy sector (Damunupola et al., 2022; Hitihamu, 2022; Sullivan, 2020; Vidanarachchi et al., 2019; Vyas et al., 2020). It is hard to argue against these points because what is being said above is the essence of what is known as strategic management: strategy planning, strategy implementation, and strategy monitoring (David & David, 2015; Whittington et al., 2020).

The researcher is of the view that the dairy industry in the country is not short of policies. As mentioned earlier, there are many policies aimed at governing the industry. It is one thing to have policies written down on paper and another thing to have these policies effectively implemented at the grassroots level to improve dairy production using the country's bureaucratic machinery. The following statement of Vidanarachchi et al. (2019) sumps up the ineffectiveness of policies: "After seven decades of improvement attempts, the national milk production at present satisfies only 45% of the national requirement. What were the impediments which prevented the dairy development programs from achieving the desired goals?"[11]

## 1.3 Motives for the research

Motivation plays a pivotal role in shaping the journey and success of any research endeavor, particularly in doctoral studies. As highlighted by Litalien et al. (2015), intrinsic and identified motivations significantly influence academic performance, persistence, and well-being. In this research, the motivation arises from a combination of personal interest, academic background, and a commitment to addressing challenging yet impactful goals. These motivations are elaborated on through three key reasons, as outlined below.

### 1.3.1 Personal interests and the researcher's academic background

The researcher's academic journey towards pursuing a PhD in Logistics and Supply Chain Management at Massey University (Course Code: 240.900) began during her undergraduate years when she undertook a four-year Bachelor of Business Administration (Marketing) course (2008–2011) in Sri Lanka. She soon realized that SCM involves more than managing material flows and exchanging information, such as purchase orders and their downstream ripple effects. The researcher realized that SCM also emphasizes building relationships between SC actors to maximize value, as an aspect that goes with relational marketing.

As an extrovert, the relationship-building aspect of SCM, coupled with the role SD plays in fostering long-term partnerships, deeply resonated with the researcher. The skills of the lecturer who delivered SCM modules in the undergraduate course further fueled her interest in SD, inspiring her to explore the topic as part of her master's research. While the researcher's master's research focused on apparel SC in Sri Lanka, her interest in SD grew further.

The researcher's subsequent role as a lecturer in SCM at the University of Peradeniya, Kandy, Sri Lanka, and her ability to secure a partial scholarship with study leave to pursue a PhD, provided the opportunity to conduct advanced research in a topic she is passionate about.

[11] Vidanarachchi et al. (2019) highlighted that dominance of smallholder farmers, lack of integration and coordination among the development programs, inadequate consideration of the ground situation (genetic constraints, breeding issues, lack of nutrition, feeding challenges, lack of capacity building, milk quality issues) and not considering the long-term consequences of implementation as the main reasons for failure.

Completing this PhD will mark the fulfillment of a personal goal (the rationale for selecting the Sri Lankan dairy VC will be explained shortly).

### 1.3.2 Challenging goals to achieve

Although SCM and agribusiness fields—two of the disciplines through which the researcher needs to create her fusion—have synergy through topics such as VCs and relationships (physical goods VCs are more common in SCM, but in agribusiness, the VCs are invariably, AVCs creating some separation), the academic priorities of the two disciplines seem to differ to some extent. Compared to agribusiness, SCM is more focused on building and testing middle-range theories on SCs (Craighead et al., 2024; Wu & Jia, 2018) from established grand theories; hence, the use of the term "theoretical lens" is common in SCM[12]. Agribusinesses on the other hand focus on agriculture production management, sales and marketing, managing finances, policy, rural economies, and so forth—in addition to VCs—that involve different types of theoretical priorities (Thakur et al., 2024). The challenge was how to conduct a doctoral study on logistics and supply chain management without undermining the focus areas of agribusiness.

### 1.3.3 Potential impact of the study

Developing and testing a theory that explains and predicts the outcomes of supplier (farmer) development initiatives (Chapter 5) including supplier capability (e.g. meeting delivery and quality requirements) and supplier's TBL sustainability is important to academia, practitioners (especially the processors) and policymakers because a good theory can explain/predict where things are going right and where things are going wrong (e.g., specific unsuccessful farmer development initiatives). This work also led to two other pieces of work (Chapters 6 and 7) that are potentially impactful.

Sri Lanka's dairy sector is quite underdeveloped, despite the country having a great portal to be self-sufficient in milk production and thereby rural community upliftment. As a Sri Lankan doctoral student the researcher is quite passionate that her doctoral study would benefit Sri Lanka in some way—in the researcher's humble opinion, the studies covered in chapters 5, 6, and 7 in that order, are the ones that have the highest theoretical, practical, policy

[12] SCOPUS returned 110 articles search words "theoretical lens" AND "supply chain management" in article title, abstract, and keywords but she returned 71 articles for search word combination "theoretical lens" AND (agribusiness OR agriculture OR "food systems"); not all of these were found to be agribusiness related (just 1 article for "theoretical lens" AND agribusiness).

implications—now that the researcher looks forward to postdoctoral engagement in further working on the research topic.

## 1.4 Aim and research objectives

Existing theorizations posit that SD results in supplier performance improvement and strengthened buyer-supplier relationship—both of which result in long-term benefits to both the buyer and the supplier (Benton et al.,2020; Krause et al., 2007; Mukucha & Chari, 2021; Yawar & Seuring, 2020). The researcher is not proposing counterpropositions to this, although whether a particular SD initiative improves supplier performance seems to be context specific (details in section 2.2.3 in the next chapter). The pressing question is that, although SD may result in improving supplier's performance in terms of delivery and quality performance (the mandatory fields of supplier performance) and other manifestations of supplier performance covered in the literature, will these improvements lead to improvement of supplier's TBL outcomes—if not all three, at least two TBL outcomes—to demonstrate SSD, in the study context, where the supplier is the farmer and buyer is the milk-processor?

The above question cannot be answered without understanding the causal mechanisms covering farmer development initiatives (processor-led), farmer performance (in a conventional supplier performance sense), and a farmer's TBL performance. Expressed in another way, although the cause (farmer development initiatives) and the effect (farmer's TBL performance) remain clear, the constructs that intervene in the above cause-and-effect relationship and the causal paths need to be hypothesized and tested to obtain a comprehensive understanding of the SSD phenomenon. Since two farmer performance outcomes are covered in the study—farmer performance in a conventional supplier performance sense and farmer's TBL performance—with justification, the researcher labels the former as 'farmer capability'.

The study aims to develop and test a theory on dairy farmers' sustainable performance. To realize this aim, the following specific research objectives (RO) were specified:

RO1: To study the dairy VC of Sri Lanka to understand how farmer development takes place through a milk processor

This research objective is justified on the grounds that theory development and testing (the next objective) in a poorly understood context require scoping the theory/study.

RO2: To develop and test a theoretical model that predicts and explains the relationship between processor-led farmer development initiatives, farmer capability, processor-farmer relationship, and a farmer's sustainable performance.

This research objective is important as it bridges the gap between theory (predicting and explaining things that happen, in abstract form) practice (the happening itself). Equally importantly, there is a knowledge that justifies the theoretical model (covered in detail in the next chapter).

RO3: To analyze farmer heterogeneity to enable milk processors and other interested parties to better focus on farmer development initiatives

This research objective is justified because analyzing farmer heterogeneity to identify relatively homogeneous groups allows for tailored development interventions; this makes farmer development more efficient and effective.

RO4: To develop an index to measure the overall sustainable performance of dairy farmers and facilitate efficient, sustainability-focused development.

If the buyer (the milk processor in the Sri Lankan context) aims to promote the sustainable development of farmers, they require a tool that can quickly and accurately capture the sustainable performance of potentially thousands of farmers. The overall sustainability index would serve this purpose, thus justifying RO4.

## 1.5 Research questions

Research questions (RQ) act as guiding beacons, steering the investigation and shedding light on the research process. They emerge from identifying gaps in existing literature, curiosity about specific phenomena, or the need to address practical problems (Bryman, 2016; Sandelowski, 2000). The following RQs have been formulated to address the knowledge gaps to provide direction for the study:

RQ1. Do milk processors in Sri Lanka develop their farmers in any tangible way? If the answer to this question is *'yes'*, how do milk processor-led farmer development initiatives improve a dairy farmer's capability?

RQ2. Does enhancement of a dairy farmer's capability resulting from milk processor-led farmer development initiatives have a positive impact on sustainable farmer performance?

RQ3. How can smallholder and medium-scale dairy farmers in Sri Lanka—farmers are heterogeneous by nature—be grouped into relatively homogenous groups based on their performance, in order to provide customized farmer development programs to suit each performance group?

RQ4. Is it possible to develop a quick and efficient way of identifying a farmer's current level of sustainable performance, to facilitate farmer development?

The above RQs will be justified fully in the next chapter (Literature Review) upon highlighting the three knowledge gaps. Figure 1.7 depicts the nexus between the three knowledge gaps and the four ROs of the study.

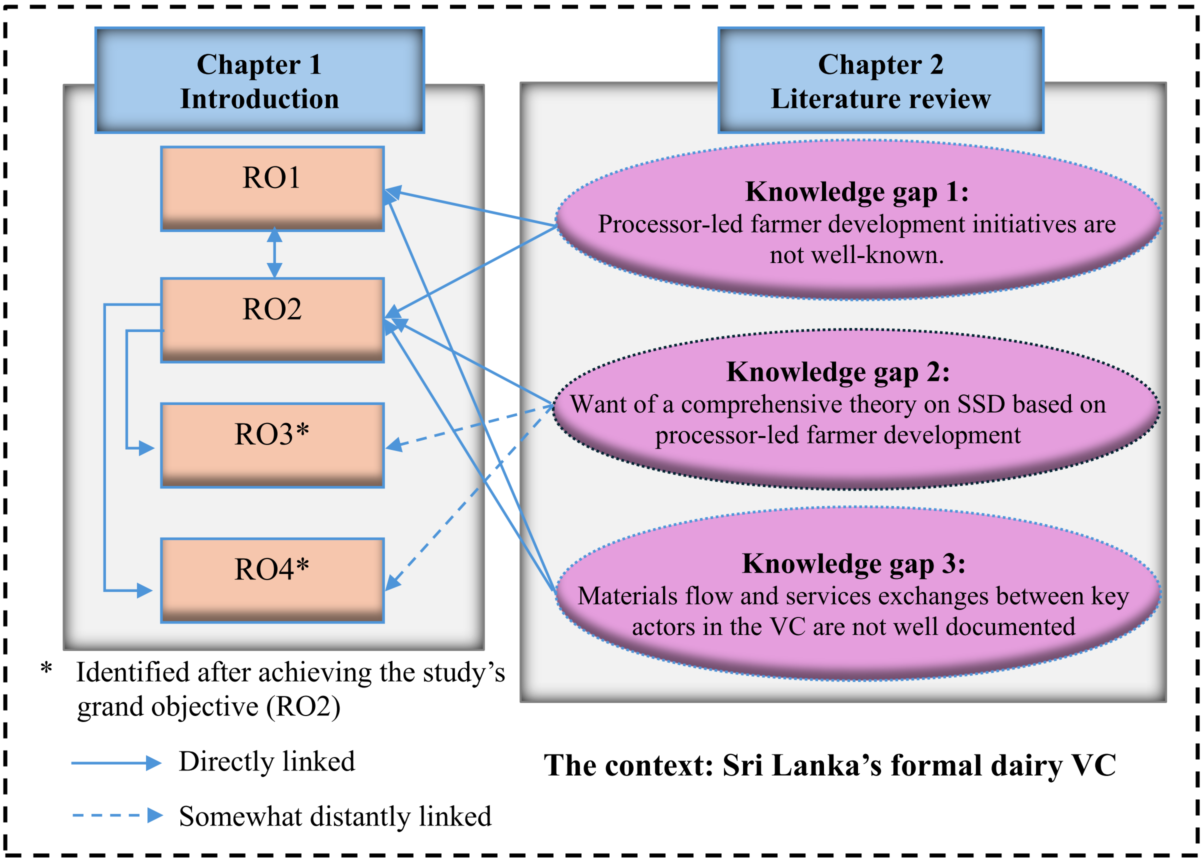


**Figure 1.7 The nexus between the ROs and knowledge gaps identified in the literature review in Chapter 2**

*(Source: Own work)*

As in Figure 1.7, RO2 is the grand objective of the study, although RO1 needs to be achieved before to achieve RO2 because without properly understanding the context, it is risky to develop and statistically test the researcher's theoretical model—with large sample data—that is expected to be generalizable across the Sri Lankan dairy VC. The researcher found that the phenomenon of "processor-led farmer development" is not well-understood, within or outside the context of Sri Lanka. Setting RO1 ensures that the researcher knows how to capture the farmer development initiatives and other variables associated with her model (referred to RO2), and that she approaches the right farmers to collect quantitative data to test her model. RO3 and RO4 are upshots of conducting what the researcher calls as her flagship study, which stems from RO1. More details on the nexus between gaps, ROs, RQs, knowledges gaps and the thesis chapters can be found in Figure 1.10 provided at the end of this Chapter.

## 1.6 Novelty of the study

The study adds novelty in at least two ways.

### 1.6.1 Novelty in the theoretical model

Nearly all empirical studies (especially quantitative studies, not so much case studies) on the effects of SD in the operations and SCM disciplines have been conducted from a buyer's perspective. Although SSD emphasizes that SD efforts must result in improvement of supplier's TBL performance, the research still seems to focus on traditional manifestations of supplier performance—delivery, quality, flexibility, relationships, knowledge transfer, and so on—arguably because these manifestations are value-creating and hence important to the buyer in becoming competitive (Benton et al., 2020; Modi & Mabert, 2007; Wagner, 2009; Yawar & Seuring, 2020). The researcher theorized that a supplier's ability to achieve TBL outcomes is the result of improvements in two key areas: (i) traditional norms of supplier performance (collectively conceptualized as farmer capability), and (ii) buyer-supplier relationships. This theorization draws insights from operations management theory (particularly SD), and agribusiness theory (specifically the contextualization of SSD within the agricultural sector in a developing country context). The aim was to provide a more comprehensive understanding of SSD and offer a novel perspective on how processor-led farmer development initiatives drive sustainable farmer performance, mediated by farmer capability and the processor-farmer relationship.

### 1.6.2 Novelty in the context

The researcher observed that a great deal of peer-reviewed research on SD is focused on the non-perishable goods manufacturing sector, especially in developing countries (Bai & Satir, 2022). Sustainability has been studied in a standalone fashion without a clear and holistic understanding of how its pieces of economic, social, and environmental outcomes can fit together to create overall sustainable performance (Carter & Easton, 2011). Although sustainable farmer development is a significant theme in agriculture and agribusiness literature, these fields differ in focus. Specifically, the idea of a buyer actively developing their farmers is not strongly emphasized (See 2.5.3 in the next chapter for details).

Unless SD research in AVCs is carefully scoped to theorize SSD within the study's context, the findings may provide decision-makers with irrelevant information. Since decision-makers often rely on assumptions or heuristics to address their limited familiarity with academic research, this could result in suboptimal outcomes (Morvan & Jenkins, 2017; Tversky & Kahneman, 1974). Alternatively, they may resort to time-intensive trial-and-error methods, which are both inefficient and potentially ineffective (Cyert & March, 2015; Simon, 1972; Sweller, 1988). These challenges underscore the need for context-specific, empirically validated frameworks to guide decision-making. In addressing this issue, the researcher developed and empirically validated SSD initiatives specially for agribusiness (dairy in particular) in a developing country context. The researcher went on to explain who can initiate SSD in an AVC (the focal company,) what SSD entails, and how SSD initiatives lead to sustainable farmer performance.

## 1.7 Research methods overview

As alluded to earlier, this thesis has been written in the thesis with publications mode. Consequently, each paper (Chapter 3-7) contains its own introduction, literature review, methodology, results, discussion, and conclusion.

### 1.7.1 Research paradigms

A research paradigm is a framework that guides how research is conducted, encompassing the beliefs, values, and techniques that inform the researcher's approach, and it consists of the researcher's ontology, epistemology, methodology, and axiology (Guba, 1990; Guraya et al., 2023; Lincoln et al., 2011). Of these, the researcher's ontology and epistemology are the key because these influence the researcher's line of inquiry, hence determine the methodology and the methods being used to achieve the research objectives (Bryman & Bell, 2015; Creswell, 2014). Ontology examines the "nature of reality" in answering the question "what is reality?" (Bryman & Bell, 2015; Creswell, 2014). Based on one's belief system, reality can be viewed as *singular* and objective (the natural science ontology) or *multiple* and subjective (Guba, 1990; Lincoln et al., 2011). Epistemology refers to gaining an understanding of reality; as such, epistemology can be viewed as the "theory of knowledge"—that is justifying how the researcher knows that they know what they are supposed to know (Lehrer, 2018). Epistemology is related to truth in that one's epistemology enables one to accept more of one's beliefs as true and less of one's beliefs as false (Astley, 1985; Rawnsley, 1998). The researcher's methodology—their high-level strategy used to gain insights by designing the study—follows from their epistemology (Berryman, 2019; Rawnsley, 1998). The axiology refers to the researcher's personal beliefs and values and how they influence conducting the research (Crotty, 1998; Hart, 1971). Three paradigms—positivism, interpretivism, and pragmatism—are reviewed briefly to justify the researcher's paradigm.

#### *1.7.1.1 Positivism and post-positivism*

The epistemology in *positivism* takes the position that reality *can be captured,* and knowledge claims should be made through formulation and testing of falsifiable hypotheses (Hull, 1999). Thus, the methodology associated with positivism is hypothetic deductive (Lincoln et al., 2011). The deductive reasoning in positivism consists of six sequential stages: theory, hypothesis, data collection, findings, hypothesis confirmation or falsification, and revision of theory (Bryman & Bell, 2015). Methods incorporated within the positivist methodology involve quantitative methods such as experiments, surveys, and statistical analysis associated with these methods. Positivists use value-free language in disseminating their results to isolate them from the phenomenon being studied to fall in line with the positivistic ontology.

*The post-positivism* is an extension of positivism—one can view post-positivism as an adjustment to positivism without threatening the epistemological roots of the latter—with some relaxation to the rigid positivist stance of sole reliance on hypotheses and experiments to advance knowledge (Maksimović & Evtimov, 2023; Ryan, 2006). Consequently, post-positivism recognizes that all observations are fallible and influenced by the observer's biases, theories, and assumptions. Post-positivists rely on numerical data for scientific generalization but at the same time, recognize the importance of understanding context and subjectivity in the meanings (e.g., construct operationalization), providing opportunities to mix multiple streams of data, including the accommodation of qualitative data (Maksimović & Evtimov, 2023; Ryan, 2006).

#### *1.7.1.2 Interpretivism*

In contrast to positivism and post-positivism, the epistemology in *interpretivism* emphasizes the subjective and socially constructed nature of knowledge, and hence reliance on qualitative data containing subjective interpretations of participants who are part of the phenomenon being studied (Lew et al., 2018; Lincoln et al., 2011). A qualitative inquiry typically begins with observations and data collection. The qualitative methodology looks for patterns, themes, and meanings within the data to develop theories or understandings (Braun & Clarke, 2006; Busetto et al., 2020). A qualitative methodology follows three sequential stages: data collection, data analysis, and theory development (Guba & Lincoln, 1994; Lew et al., 2018). Interpretivists tend to use value-laden language in disseminating their results to appreciate the fact that they are part of the phenomenon being studied.

#### *1.7.1.3 Pragmatism*

Pragmatism as a paradigm (James, 1907; Peirce, 1905) differs significantly from positivism and interpretivism in that there are no strict ontological and epistemological stances in pragmatism. Pragmatists believe that a research inquiry should be driven by practicality rather than the rigid positivistic and interpretivist notions embedded in the latter two methodologies (Creswell & Creswell, 2017; Morgan, 2014). One salient feature of pragmatism is the room to mix qualitative with quantitative methods—commonly known as mixed methods designs—to better understand the social world (Creswell & Clark, 2011).

According to Creswell and Clark (2011), mixed method research designs can be designed to mix quantitative and qualitative phases in six different ways. In the *convergent parallel design*, quantitative and qualitative phases run in parallel, and both phases are given equal weight. In the *explanatory sequential design*, the quantitative phase is run first, and the findings of this phase are used to design the qualitative phase. In the *embedded design*, one phase is nested within the other phase of the design within a single study (e.g., a survey nested within a case study or vice versa). In the *multiphase design*, the sequential and concurrent components are mixed within a well-defined timeframe. In the *transformative design*, the researcher mixes the quantitative and qualitative components in a suitable way to evolve a transformative theory. Finally, in the *exploratory sequential design,* an exploratory qualitative design is followed by a quantitative design.

### 1.7.2 The researcher's paradigm and the methodology

Interpretivism can be excluded as a suitable research paradigm, given the objectives of the study. The researcher's research design requires operationalizing constructs (i.e., developing measurement scales and indices to measure the variability of the constructs), formulating hypotheses, and testing them using quantitative data via statistical techniques to test hypotheses, these do not align with interpretivism and qualitative methodologies. Positivism—

or more specifically, post-positivism—offers a more attractive approach, as it allows the researcher to perform the aforesaid tests while engaging with the Sri Lankan dairy industry to gain a deeper understanding of the context before proceeding with construct operationalization, quantitative data collection, and hypothesis testing. Thus, the researcher has adopted a *postpositivist* paradigm to achieve her research objectives.

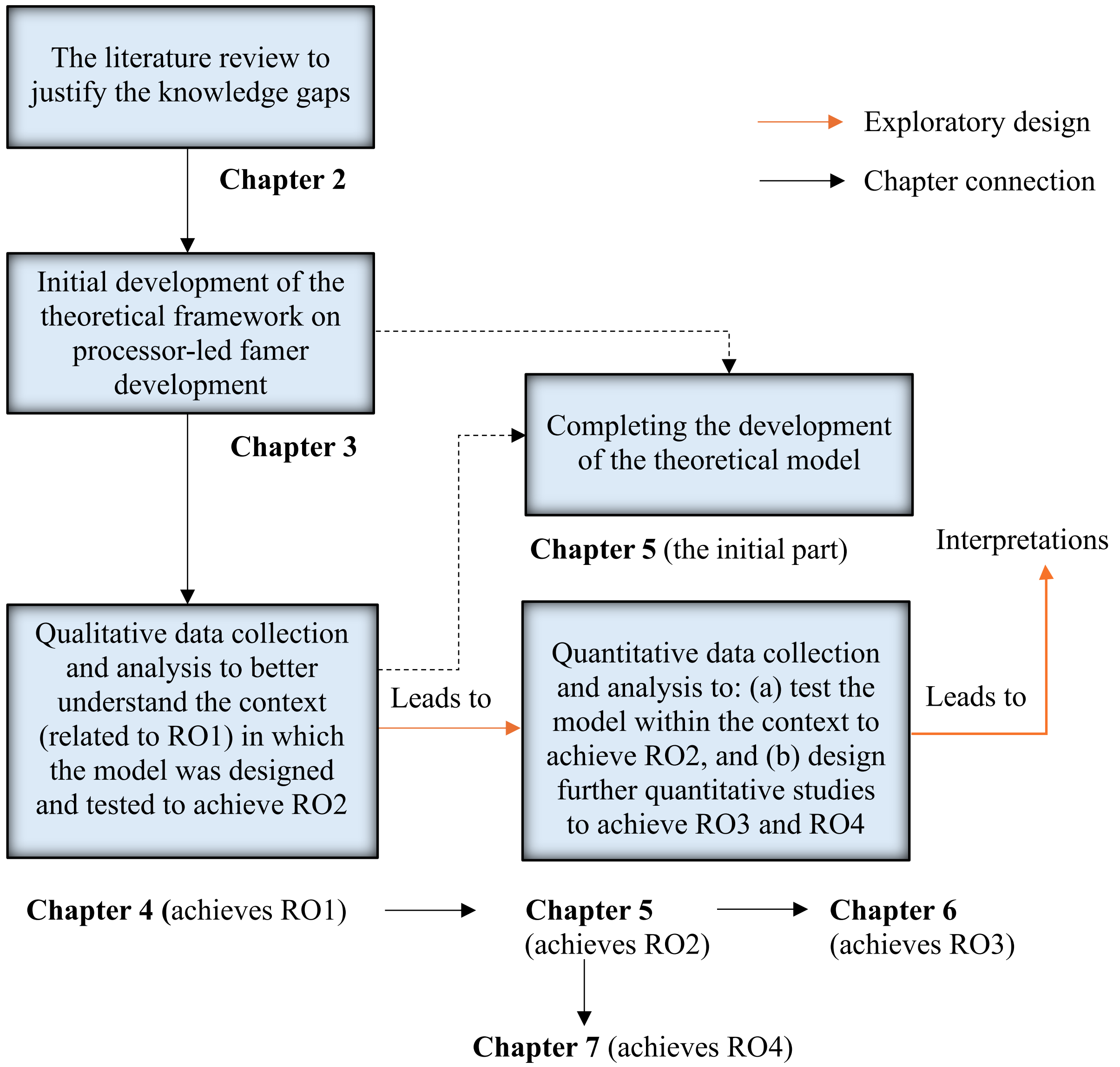


**Figure 1.8 Exploratory sequential design adopted by the researcher**
*(Source: Own work)*

In the researcher's design, as shown in Figure 1.8, there are elements of an exploratory sequential design as described by Creswell and Clark (2011), recognized authorities on mixed-method designs. This is because prior to hypothesis testing, the researcher engaged with the industry via interviews—this resulted in qualitative data collection and analysis—to understand the context within which the hypotheses were developed and tested.

### 1.7.3 Data collection

*1.7.3.1 Phase I of data collection: Field work/qualitative*

Answering the four research questions revolved around the use of *quantitative data* for testing the hypothesized theoretical relationships (Figure 1.8) involving the eight constructs, and then using the indicator scores, construct scores, and other relevant quantitative data to conduct the remaining statistical modeling (i.e., farmer cluster identification and sustainability index construction).

Although constructs were operationalized using the extant literature (see Chapter 3), before that, fieldwork through engagement with the Sri Lankan dairy industry was essential to address uncertainties, such as identifying specific milk processors actively involved in developing dairy farmers, understanding how dairy farmers are selected for development programs, clarifying the nature of the relationship between farmers and milk processors (e.g., whether it is a straightforward buyer-supplier relationship or a more complex one involving merchant intermediaries), and identifying specific farmer development initiatives.

**Table 1.2 The profile of interview participants and the interview stages**

| Stage | VC Actor | Method of Data Collection | No. of Interviews |
|---|---|---|---|
| 1 | Senior officials and technical officers | Semi-structured face-to-face interview/video conference | 5 |
| 2 | Milk processors | Semi-structured face-to-face interview/video conference and secondary data; 1 interview per processor | 4 |
| | Milk collecting centers | Semi-structured face-to-face interviews, observations, and secondary data; 1 interview per milk collection center | 3 |
| 3 | Dairy farmers (small-medium scale) | Semi-structured face-to-face interviews, observations, and secondary data | 11 |
| | Large-scale dairy farms | | 1 |
| | Milk collectors | | 6 |
| | | **Total** | **30** |

Industry engagement, that is Phase I of data collection (from 01/2022 to 04/2022), was conducted in three stages as outlined in Table 1.2 (details in Chapter 4). The semi-structured interview helped in building new ideas and patterns that were previously known (Bell et al., 2022). In Phase I of fieldwork, video conferencing was used when face-to-face interviews were deemed impractical, mainly due to COVID-19 travel restrictions prevailed in Sri Lanka[13]. Snowball sampling was used in identifying the participants, which was useful in gathering data from a fragile population, as samples needed to be collected using a multiple-stage process within a social context (Naderifar et al., 2017).

In stage 1, the interviews were conducted with the senior officials and technical officers in the English language to gain scientific information (e.g. animal science insights such as animal nutrition and health) related to milk production, milk productivity, and related infrastructure, such as the policy framework. This background knowledge was deemed necessary to interview the milk processors (stage 2). The semi-structured interview guide with 13 main questions was used in stage 1 (See Appendix A).

In stage 2, four milk processors and three milk collecting centers were interviewed using a semi-structured interview guide that contained 27 items (See Appendix B). Three large milk processors and one small milk processor were selected based on the suggestions made by the informants in Stage 1. Accordingly, one privately owned, one government-owned, one multinational company and one small privately owned milk processing company represented the sample. The large privately owned milk processor was found to be equipped with a demonstrable farmer development program, its own bank for providing financial support for farmers, and a sizable number of farm extension officers to support their farmers, making this processor more suitable for the quantitative stage of data collection. The company was also willing to support the study by way of showing their farmer registers for each district, providing contact details (e.g. names, phone numbers) of their farmers, and providing non-confidential administrative records (e.g., details on farmer training) the researcher wanted.

In stage 3, 11 small and medium-scale farmers were interviewed using the farmers' native languages (Sinhala or Tamil, depending on the farmer). A research assistant (RA) was used to interview Tamil-speaking farmers (n=6) as the researcher does not speak Tamil. Semi-structured interview guide used for interviewing farmers contained 32 items (See Appendix C). The criteria used for selecting dairy farmers were that they should supply more than 50% of their milk to the identified milk processor, and confirmation that they are being supported by their milk processor to improve their outcomes. In addition, the farm manager of one large-scale government-owned farm was interviewed using a semi-structured interview guide that

[13] The interviews were conducted by the researcher except for interviewing one milk processor (a small company) in the Jaffna district, and 3 dairy farmers (2 farmers in Nuwara Eliya and 1 farmer in Jaffna) in Tamil Language.

contained 23 items. The main reason for this interview was to obtain contextual information on the dairy VC (See Appendix D). In addition, six milk collectors were also interviewed. Questions asked from the milk collectors were limited to the payment arrangements, milk hygiene, and understanding how their role affects (positively or negatively) the farmer-processor working relationship (See Appendix E).

The data saturation (Creswell & Creswell, 2017) reached at 30th informant where it started a pattern of repeated data arising (Bell et al., 2022). The interviews were planned for a duration of one hour for the farmers (they were often not eloquent, even in their native language) and 90 minutes for the processors. However, in actual fact, the interviews lasted between 45 minutes to two hours, depending on the key informant. All the interviews were recorded using a voice recorder (with the permission of the interviewee) and were manually transcribed into English (with the farmer, translation into English from the native language). All the questions asked had a basis (i.e. literature review). For example, the literature (Möller & Törrönen, 2003) covers several bases of the supplier's value creation capability. The interviews enabled the researcher to gauge a farmer's awareness of these capability bases.

In addition to the primary source of data collection (i.e. interviews), observations and secondary data were collected and used to ensure construct validity (from a positivist case researcher sense) by triangulating evidence (e.g., what is being documented and what is being said) shared between multiple sources. The secondary data included administrative records maintained by the processor (e.g. the farmer register, farmer development evidence), and records on farmer training (e.g. booklets, record book given by the milk processor, records of attending training programs conducted by the milk processor) (See Appendix K).

#### *1.7.3.2 Phase II of data collection: Developing the survey instrument and administering it*

##### *(a) Developing the survey instrument*

A survey instrument (a questionnaire) was developed to operationalize the constructs of the research model and to obtain farmer/farming demographic data required for the quantitative studies (Chapters 5-7). The extant literature was used to operationalize the eight constructs of the theoretical model (i.e., to determine the indicators of the theoretical model) (See Chapter 5 Appendix 1). The indicators used for operationalizing each construct were the ones that were included in the literature and the ones that were, at least to some degree corroborated by the fieldwork (please see the supplementary document to Chapter 4 for more information). The unit of analysis as well as the unit of measurement is the individual farmer who supplies milk to their processor. Farmers who are being trained—based on the milk processor's training register—who supplied milk to the large privately owned milk processor were selected to participate in this phase of data collection.

The survey instrument (Appendix F) had two sections. Section A of the survey instrument contained 39 statements covering the 39 indicators of the eight constructs of the theoretical model. The participants (farmers) were asked to agree to each statement (two were reverse coded) in a five-point Likert-type scale (1-strongly disagree, 2-disagree, 3-indifferent, 4-agree, 5-strongly agree) for all statements but the statements listed under farmer capability, for which the following five-point scale was used: 1-very low, 2-low, 3-neither low nor high, 4-high, 5-very high. Section B of the survey instrument contained several questions that captured farmer and farm characteristics.

Four experts—two academics knowledgeable about the context and two senior practitioners in the Sri Lanka dairy industry who has experience in the field—were asked to review the statements in section A of the survey instrument for relevance, sufficiency, and clarity. The purpose of this exercise was to establish the content validity of the constructs (Almanasreh et al., 2019; Nunnally & Bernstein, 1994), as operationalized via the survey instrument. No omissions or redundancies were detected by the experts.

The original survey instrument prepared in English was translated into Sinhala and Tamil languages by professional translators (Appendix G and Appendix H). Translated questionnaires were needed because Sri Lankan dairy farmers do not speak English; nearly all the dairy farmers in the Kurunegala district speak the Sinhala language while the majority of the dairy farmers in the Nuwara Eliya district speak the Tamil language. The researcher understood that the translation of an original questionnaire into a different language (in this study two languages) might result in the risk of not measuring what the researcher is supposed to measure. Hence, the Tamil and Sinhalese translations of the questionnaire were back-translated (Fowler Jr, 2013) to English by two different translators (ones who were not involved in translating the original questionnaire) to reconcile the back translated English versions of the questionnaire with the original English version. The Tamil version of the questionnaire needed revisions, which suggested the nuances of that language.

Four research assistants (RAs)—four fourth-year honors students affiliated with the University of Peradeniya, Kandy Sri Lanka—were recruited to administer the survey by way of personally visiting the dairy farms in the Kurunegala district (two were deployed) and the Nuwara Eliya district (two were deployed) during the COVID 19 period (at a time when the travel restrictions were partially relaxed). A fair wage was paid to the RAs for labor, transport (all four owned motorcycles), and other expenses (e.g. mobile phone use). The RAs were allowed to visit the farms for the full-scale administration of the survey, only after their final year examinations. Training of the RAs was conducted by the researcher using the Zoom platform.

Prior to full-scale administration of the survey, the questionnaire was pilot tested using 30 randomly selected farmers in the two districts to gauge how well the farmers understood the statements (the RAs were asked to explain anything that the farmer was unclear about), the time they spent in completing their survey, and their motivation/enthusiasm in participating in the survey. No major issues were found during the pilot stage, and the pilot survey data was analyzed to ascertain whether there had been any non-random patterns emerging from the data (e.g. strongly agreeing or disagreeing with everything and not thinking about the two reverse coded statements before answering) (Fowler Jr, 2013).

As with full survey administration, pilot testing was conducted using farmers who are being formally trained by the milk processor. To become eligible for formal training, a farmer must consistently supply ≥20L of milk per day on average or own ≥5milk-producing cows and use large contingent of extension officers, according to the milk processor—a fact identified using Phase I of the study. This means that subsistence farmers do not receive the formal training provided by this milk company.

*(b) Full-scale survey administration*

For contact purposes, 400 farmers—200 from Nuwara Eliya and 200 from Kurunegala—were randomly selected from the milk processor's training registers, which had the names of the farmers, their physical addresses, and mobile phone numbers. Of the 400 farmers contacted, 324 agreed to participate in the survey, thus returning a response rate of 81%. The survey was conducted during the period April 2023 to June 2023 (full details of the survey administration are given in Chapter 5). Since RAs were deployed to visit farms and collect data, the remote-online data collection software 'KoboToolbox' (Das, 2024) was installed on the researcher's computer as well as the RAs' mobile phones. KoboToolbox not only automates data collection, but it also has the added facility of location tracking. The RAs were given clear instructions to update the location of the farm when they visited each farm. Even though the KoboToolbox mobile app had the luxury of survey questionnaires being filled out in real-time, network instability in rural areas meant that manual completion was needed. The researcher checked the data sheet on a daily basis for data accuracy, GPS location, location images uploaded, farmer details being provided (consent sheet signed and farmer photographs with permission), and scanned copies of the manually answered questionnaires. The researcher finally downloaded the data sheet containing the 324 cases from the KoboToolbox as a Microsoft Excel worksheet. See Appendix I for the information sheet used, Appendix J for the participant consent form and Appendix K for some photographs.

### 1.7.4 Qualitative data analysis

The qualitative data collected from the interviews (Phase I of data collection) were analyzed using *qualitative content analysis* manually to describe, classify, and connect the concepts that the researcher knew before the interview (Creswell & Creswell, 2017; Dey, 2003). The information gathered from all informants was used for the following main purposes: mapping the formal dairy VC of Sri Lanka, identifying its structure, governance and value flow, the key actors within the VC, examining the role of milk processors in farmer development (e.g., identifying which processors were more active, how they select farmers for training), understanding the types of processor-led farmer development initiatives available, and exploring how processors define 'sustainable farmer performance'. The qualitative data analysis provided an in-depth understanding of the study's context, which proved invaluable for successfully completing the quantitative phase of the research (phase II of the data collection).

### 1.*7.5 Quantitative data analysis*

Figure 1.9 depicts the quantitative data (the data collected from 324 farmers using the survey questionnaire) analysis techniques that were used and the scope of each analysis. The reader is solicited to view the researcher's hypothesized theoretical model with indicators shown in Chapter 5 (Figure 5.1), as well as her forerunning model shown in Chapter 3 (Figure 3.2).

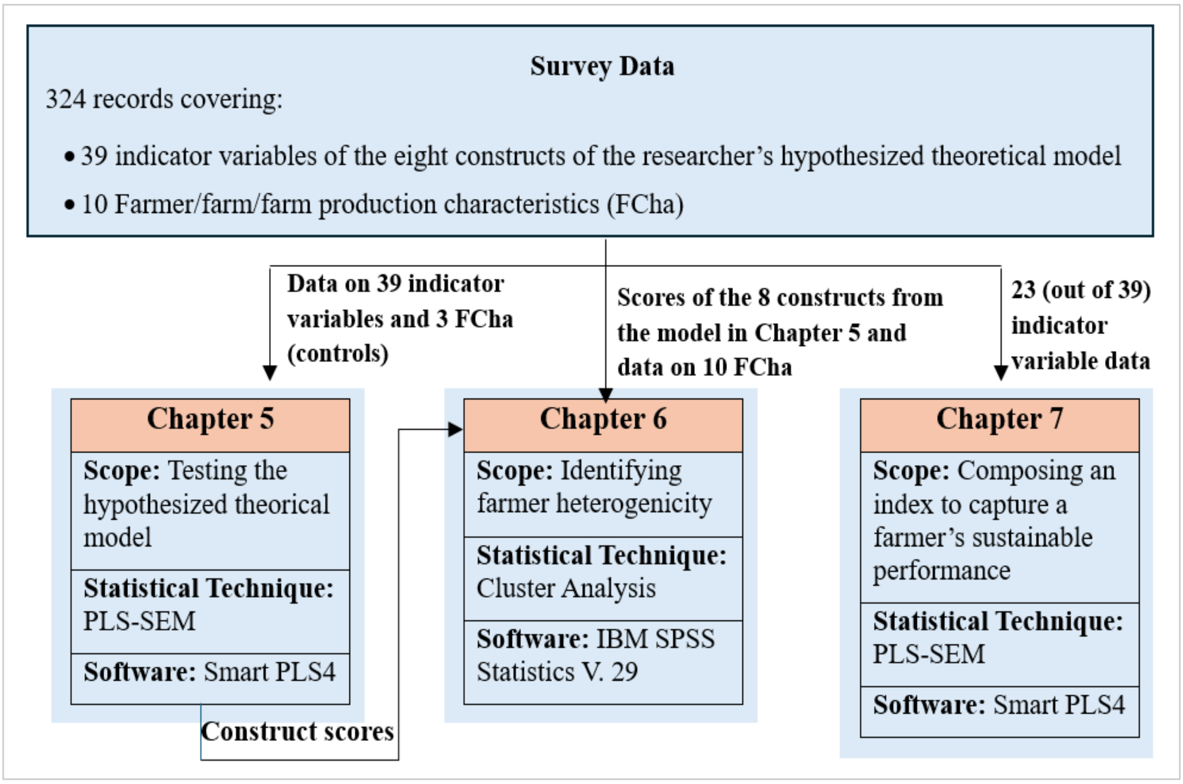


**Figure 1.9 Quantitative data analysis techniques and scope**
*(Source: Own work)*

*1.7.5.1 Testing the hypothesized theoretical model (Chapter 5)*

The hypothesized theoretical model consisting of eight constructs and nine directional hypotheses predicts and explains how processor-led farmer development leads to a farmer's TBL outcomes. In the main, the hypothesized theoretical relationships were supported by the data, which provided objective evidence of the existence of SSD in the study context.

Since constructs are abstract representations of reality—the variability of the constructs can only be captured through the variability of their indicators—a structural equation modeling (SEM) technique was used for testing the hypotheses. SEM is a statistical modeling technique that enables a researcher to model abstract concepts (i.e. constructs) more precisely (e.g. proper accounting of measurement error) before the relationships between the constructs are tested to determine the strengths of the relationships between the constructs and their significance, both statistically (e.g., based on the *p*-value of the regression coefficients) and practically (based on the effect size guidelines such as Cohen's $f^2$ used in quantitative modeling literature) (Fornell & Larcker, 1981; Hair et al., 2022; Kline, 2005).

Of the two-well known SEM approaches—the covariance-based structural equation modeling (CBSEM) and partial least squares structural equation modeling (PLS-SEM)—the PLS-SEM technique was used to test the above-mentioned hypotheses due to the flexibility this method offered, including the flexibility of allowing the use of formative constructs. The CBSEM relies on the analysis of the covariance structure of the indicator variables as reflected by the model, to estimate the unknown parameters and the model fit, which means that when a researcher is confronted with formative constructs, CBSEM becomes unsuitable for hypothesis testing (Hair et al., 2022; Kline, 2005)[14]. Although the presence of formative constructs was the main reason for using the PLS-SEM, the other reasons for using PLS-SEM were the model complexity (e.g. inclusion of control variables and surrogating additional relationships as part of robustness checks) and the need to generate the scores of the eight constructs for further analysis in Chapter 5 (See Hair et al., 2019, p. 5 for nine resaons that warrant the use of PLS-SEM).

*1.7.5.2 Farmer heterogenicity analysis (Chapter 6)*

Cluster analysis was performed using the scores of five constructs—farmer capability, processor-farmer relationship, and the three TBL sustainability constructs—as cluster-forming variables because out of the eight constructs, only the aforementioned five are related to a farmer's sustainable performance; as shown in Figure 1.9, the scores of constructs were obtained from the previous analysis.

Three clusters were identified via two-stage clustering. Each cluster presented a certain level of farmer performance and were named laggers (the farmers in the lowest performing cluster), accelerators (the farmers in the higher performing cluster, but not the highest), and leaders (farmers in the highest performing cluster). The three farmer development constructs and 10 farmer/farm/production characteristics were used as evaluating variables to examine how the scores of these variables varied within each cluster. Evaluating variables within each cluster enabled the researcher to propose how best to move farmers in the low-performing group (laggers) to a higher-performing group through interventions by milk processors and other stakeholders.

[14] Although a positivist ontology holds that reality exists independently of the observer—meaning that the existence of a construct does not depend on the presence of a measurement scale or items—and that observations reveal different manifestations of this reality (the construct), in newer behavioural science fields such as analytical marketing, information science, knowledge management, and operations management, this strict positivist view sometimes needs to be adjusted. This adjustment allows for constructs to be shaped by carefully argued indicators. Such constructs, as mentioned earlier, are known as formative constructs (Diamantopoulos & Winklhofer, 2001; Hair et al., 2022).

*1.7.5.3 Composing an index to capture the sustainability achievement level of a farmer (Chapter 7)*

By definition, an index is a weighted sum of its constituents. Thus, two questions need to be answered to calculate the above index: what are the constituents of the sustainability index? and, what should be the weight of each constituent?

All the indicator variables of farmer capability, farmer-processor relationship, and the three TBL constructs (hence 23 indicator variables altogether) were considered as variables that need to be considered in constructing a farmer's sustainability level. The weights of each indicator were estimated by fitting the indicator data to an index-creating model, modeled through PLS-SEM (details in Chapter 7). In this model, all the five constructs mentioned above were modeled as formative constructs because the focus was on aggregating the indicator variables in a statistically sound way. Having determined the weights of the indicators based on the 1-5 scales used in the survey questionnaire, the weights were re-scaled to reflect a 0–1000-point scoring system that provides more range (0 to 1000 versus 1 to 5) for practical application, which is also consistent with the scoring systems used in performance excellence frameworks such as the Baldrige Excellence Framework (Ghafoor et al., 2022; Xie et al., 2022).

## 1.8 Human ethics considerations

### 1.8.1 Background to ethics and general human ethics principles

As highlighted by Resnik (2018), concerns on human ethics in science can be traced way back to the Hippocratic oath in 400 BC. The history of science experiments is marked with events that in today's context are unthinkable. Bartholomew's experiment which involved drilling a large hole in the skull of a mentally disabled cancer patient to insert electrodes into her brain (1874), administering a rabies vaccine on a nine-year-old patient without animal trials (1885), Nazi experiments on prisoners (1940-1945), Milgram's experiments on obedience to authority (1961-1962) are prime examples of research conducted in the yesteryear (Resnik, 2018). The latter incident involving Milgram is important because that was the time the authorities in the US and elsewhere formulated the initial versions of ethical conduct in science experiments involving human participants, such as the Helsinki Declaration in 1964 (Mandal et al., 2011; Resnik, 2018).

The ethics guidelines appreciate that while advancing knowledge through experiments is important to humankind, these should not come at the expense of harming human subjects

(Pittaway et al., 2010; Resnik, 2018). Of course, science experiments can be generalized to nonexperimental scientific methods that involve an interaction between the scientist and the subject (the researcher's study would fall into this scenario). Several general principles need to be adhered to in research involving human participants: informed consent, preservation of confidentiality, rationalizing the risk, consideration of social values, sound research designs (e.g. meeting at least the minimum sample size requirement, randomization, and elimination of spurious results, subject section logic), protection of vulnerable groups (e.g. children, pregnant women, socially disadvantaged peoples), and independent review (Israel & Hay, 2006; Mandal et al., 2011; Resnik, 2018). Massey University's ethical principles—autonomy, avoidance of harm, benefit, justice, special relationships, whakapapa, tika, manākitanga, and mana—stand analogous to the aforesaid general principles (Massey University, 2017).

### 1.8.2 Specific human ethics considerations

Prior to conducting fieldwork, all the interactions with human subjects (face-to-face or otherwise) by the researcher (or her RAs) were considered: (i) the researcher engaging with the key informants in Phase I of data collection (interviews), (ii) one RA engaging with the key informants in Phase I of the data collection (interviews conducted in Tamil language), (iii) researcher engaging with her four RAs, and (iv) the four RAs engaging with the farmers face-to-face when they visit the farms to collect survey data (Phase II of data collection). Especial consideration was given, especially when the RAs (young adults in the 22–23-year age bracket nearing completion of their undergraduate education) engaged with farmers, who are peasants.

After carefully considering the nature of human engagements, the researcher reviewed Massey University's code of conduct for research involving human participants. The aim was to conduct a risk assessment and take any necessary actions to ensure the research qualified as low risk (the researcher also consulted her supervisors). Key risk-related decisions included providing training for the RAs, offering fair compensation for their efforts, and ensuring their workload did not interfere with their final exams, as previously outlined. Training the RAs was deemed essential not only to secure reliable and unbiased data but also to fully integrate them into the research team, holding them to the same ethical standards as the researcher and her supervisors. Lastly, the researcher submitted a preliminary ethics application to the primary supervisor to confirm that the study poses minimal risk to participants and does not require a Health and Disability Ethics Committee review.

The “no” answers given by the researcher to Massey University’s risk screening questions (there were 24 questions – a, b, c, to x) were accepted by the supervisor. Consequently, an online application was passed on to the supervisor for formal peer review. This process resulted in the issuance of a low-risk notice. A copy of the low-risk Ethics Notification # 4000024882 dated 12 August 2021 is shown in Appendix L.

### 1.9 Structure of the thesis

This thesis consists of eight chapters, formatted as a thesis with publications. Consequently, some information will be repetitive across thesis chapters (e.g., some content related to processor-led farmer development, the survey instrument, and survey administration), which is unavoidable. The structure of the thesis is depicted in Figure 1.10 and is described as follows. Having reached the end of chapter 1, the remaining chapters are organized as follows:

**Chapter 2**

This chapter presents the essential literature necessary to be reviewed to justify the knowledge gaps and covers three partially overlapping literature domains: SD, sustainability, and VCs. The chapter also presents the initial conceptual model to design the research methodology.

**Chapter 3**

This chapter presents the first stage in the development of the theoretical model, introduced as a generic, broad-spectrum, and adaptable framework for processor-led farmer development. The extant literature from the three review domains outlined in Chapter 2 shaped the development of this model. It comprises five propositions that collectively suggest direct and indirect farmer development initiatives improve a farmer’s value-creation capability and strengthen their relationships with the processor and that these improvements, in turn, lead to better economic, social, and environmental performance.

Although the model is not empirically testable in its current form, it is significant for two reasons. First, it serves as a forerunner to the testable model presented in Chapter 5. Second, it provides a valuable guide for framing the right questions to cover some of the theoretical constructs during the qualitative research phase (Phase I of the study covered in Chapter 4). Chapter 3 has been published in the peer-reviewed journal ‘Sustainability’ which is a peer-reviewed and open-access journal, that provides a high-quality research forum on sustainability and sustainable development.

**Chapter 4**

This chapter provides details of Phase I of data collection (the fieldwork) and the results with an accompanying discussion. Therefore, chapter 4 addresses the assessment and evaluation of AVC practices in the dairy VC of Sri Lanka. The configuration of the dairy VC of Sri Lanka was mapped to identify its structure, governance and value flow and key actors. The role of milk processors as buyers of the farmers' produce was then explored. This first step of the field study (phase I of the data collection) identified the types of farmer development initiatives implemented by milk processors, including understanding the variation in farmer development efforts among different processors and examining how farmers and milk processors interact to improve their performance. This chapter is formatted as a manuscript and has been submitted to the Journal of Agricultural Sciences-Sri Lanka, which is a peer-reviewed journal, that provides a high-quality research forum on topical issues in Agriculture. Some parts of this chapter were submitted as an abstract and presented at the DevNet conference held in Dunedin, New Zealand from $4^{th}$ – $6^{th}$ December 2024.

**Chapter 5**

This chapter begins by further developing the theoretical model introduced in Chapter 3, focusing on construct operationalization and hypothesis formulation—essentially converting the propositions of the earlier model into testable hypotheses. The chapter also covers the development of the survey instrument (the questionnaire), the selection of the sample, administering the survey to collect quantitative data (Phase II of the data collection), the hypothesis test results, and the discussion of the findings. This chapter is in the second round of the peer review in the journal 'International Journal of Productivity and Performance Management', which is a Q1 journal belonging to the Emerald (UK) publishing group. Based on the nature of the comments of the reviewers, the researcher expects the paper to be published in the near future. Some parts of this chapter were presented as an extended abstract at the Australasian Agricultural Resource Economies Society (AARES) conference held in Canberra, Australia from $7^{th}$–$10^{th}$ February 2024.

**Chapter 6**

This chapter analyses the heterogeneity among dairy farmers in the study context. As mentioned earlier, cluster analysis was used to identify empirically discrete clusters of farmers, based on their performance in terms of their capability (construct 1), relationships with the processor (construct 2), economic performance (construct 3), social performance (construct 4), and environmental performance (construct 5). The five constructs served as cluster variables in creating the performance clusters. The clusters were characterized using the farmer development initiatives and 10 farmer/farm/farm production characteristics as evaluation variables. The scores of the five constructs mentioned above as well as the scores of the constructs covering different types of farmer development initiatives required for the analysis were obtained from the study covered in Chapter 5. This chapter is in the second round of the peer review in the journal ‘Benchmarking: An Internal Journal’, which is a Q1 journal belonging to the Emerald (UK) publishing group. Based on the nature of the comments of the reviewers, the researcher expects the paper to be published in the near future.

**Chapter 7**

This chapter empirically develops and tests an index on the dairy farmer sustainability for the Sri Lankan context. The variables that create the index come from the conceptualization covered in Chapter 5, and therefore, the data that are used to test the index come from the same survey instrument referred to in Chapter 5. Through the index, the chapter develops an easy-to-use performance measurement framework to evaluate sustainable outcomes achieved by small and medium-scale dairy farmers on the Sri Lankan dairy VC. The proposed framework—aligned with the United Nations' Sustainable Development Goals (SDGs) and the triple-bottom-line (TBL) sustainability framework—offers milk processing companies a tool to monitor and guide farmers in improving both processes and outcomes. This chapter is under peer review in the Journal ‘Contemporary South Asia”. Additionally, an extended abstract based on this chapter was presented at the New Zealand Agricultural Resource Economies Society (NZARES) conference held in Wellington, New Zealand from 29$^{th}$–30$^{th}$ August 2024.

**Chapter 8**

This chapter concludes the study and, in doing so, demonstrates: (i) how the study objectives were achieved, (ii) the contributions made by the study from theoretical, practical, and policy perspectives, (iii) the study's limitations, (iv) potential avenues for further research, , and (v) a personal reflection on the PhD journey.

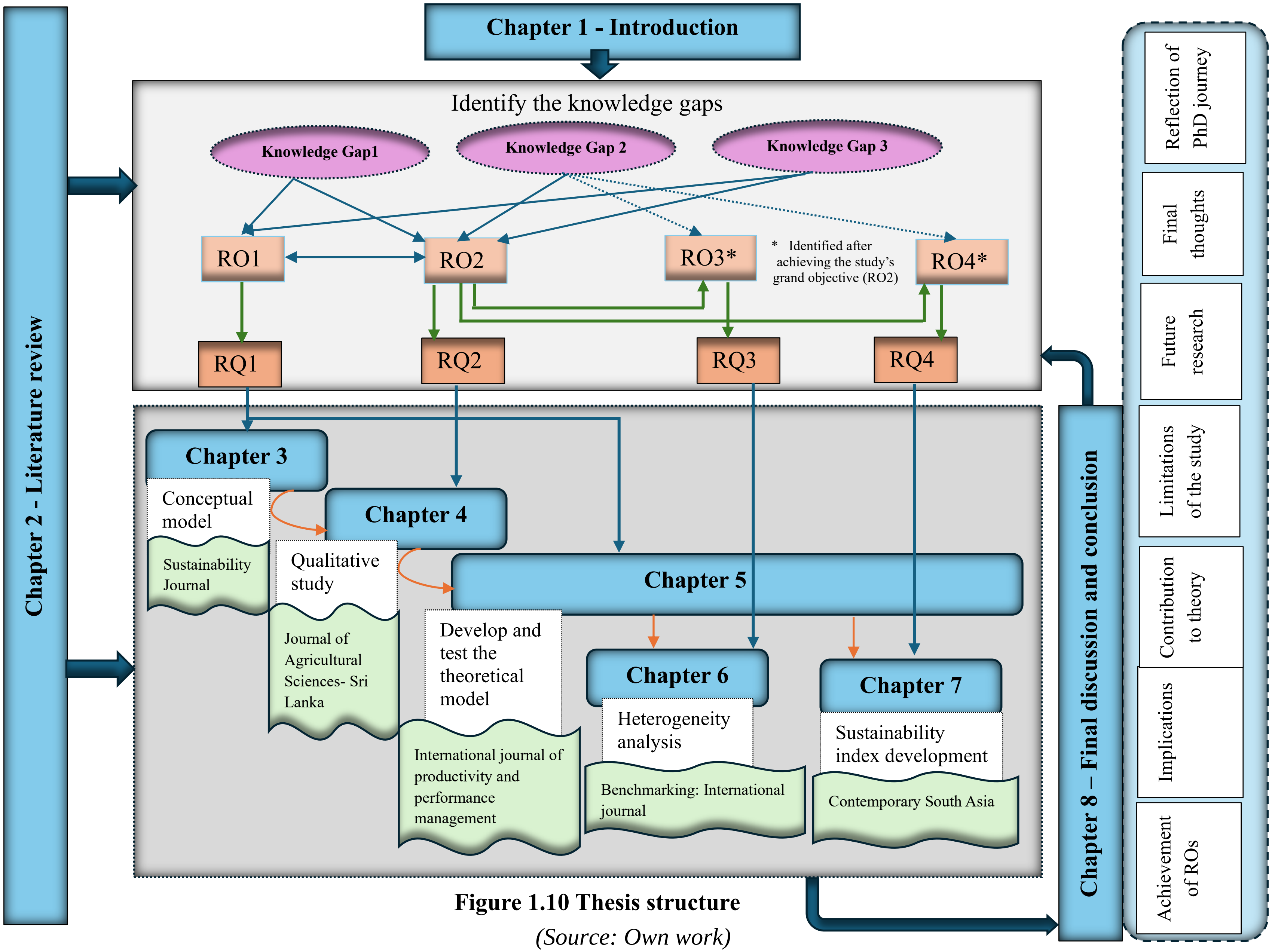


**Figure 1.10 Thesis structure**

*(Source: Own work)*

**Chapter 1, Appendix 1: Sri Lanka key dairy statistics in 2023**

| Province | No. of farms | District | Cattle population* | Milk production (L) | No. of chilling centers | Milk collection (L) |
|---|---|---|---|---|---|---|
| **Western** | 11,731 | Colombo | 5982 | 4,482,034 | 2 | 1,074,006 |
| | | Gampaha | 21,951 | 16,057,869 | 9 | 3,005,889 |
| | | Kalutara | 14,397 | 7,114,296 | 6 | 1,080,083 |
| **Central** | 22,661 | Kandy | 21,981 | 10,614,935 | 18 | 8,025,345 |
| | | Matale | 22,114 | 10,457,108 | 13 | 16,899,197 |
| | | Nuwara Eliya | 35,424 | 53,828,234 | 27 | 56,334,028 |
| **Southern** | 10,296 | Galle | 10,497 | 5,280,187 | 2 | 636,335 |
| | | Matara | 6,352 | 2,818,966 | 2 | 396,132 |
| | | Hambantota | 32,319 | 6,165,659 | 2 | 2,298,305 |
| **Northern** | 46,738 | Jaffna | 74,493 | 17,043,432 | 5 | 4,298,256 |
| | | Kilinochchi | 56,541 | 5,654,529 | 4 | 2,506,381 |
| | | Mannar | 91,392 | 1,820,105 | 3 | 1,100,167 |
| | | Vavuniya | 113,863 | 12,009,132 | 5 | 2,867,258 |
| | | Mullativu | 83,122 | 5,819,353 | 5 | 3,058,128 |
| **Eastern** | 86,330 | Batticaloa | 322,104 | 3,730,341 | 15 | 2,327,266 |
| | | Ampara | 110,997 | 9,359,428 | 15 | 9,924,150 |
| | | Tricomalee | 107,536 | 5,620,020 | 9 | 4,821,624 |
| **North-Western** | 30,476 | Kurunegala | 117,069 | 40,886,942 | 42 | 35,904,835 |
| | | Puttalam | 46,138 | 12,850,309 | 14 | 5,989,588 |
| **North Central** | 41,493 | Anuradhapura | 148,179 | 44,441,827 | 52 | 51,302,418 |
| | | Polonnaruwa | 71,743 | 10,753,645 | 15 | 11,118,893 |
| **Uva** | 12,053 | Badulla | 35,806 | 19,409,462 | 12 | 12,429,519 |
| | | Moneragala | 24,918 | 6,007,159 | 10 | 6,224,045 |
| **Sabaragamuwa** | 5,069 | Ratnapura | 8,379 | 2,397,375 | 4 | 957,195 |
| | | Kegalle | 7,501 | 2,439,430 | 2 | 316,108 |
| **Total** | | | 1,574,918 | 317,061,777 | 293 | 244,895,153 |

**Note:** *Total cattle population details are shown. Source: Department of Animal Production and Health (2023)[15]

[15] The researcher noticed a mismatch between the numerical values published by the two main relevant government authorities i.e., Department of Animal Production and Health and Department of Census and Statistics. This variation may result from differences in data collection methodologies or reporting timelines. This inconsistency not only highlights a limitation in the current data but also points to the need for future research to standardize and reconcile such figures to ensure more reliable datasets for policymaking and academic analysis.

**Chapter 1, Appendix 2: Notable dairy development projects implemented in Sri Lanka (Through government and other related institutions)**

| Project Name | Purpose | Funder and Duration | Lessons learned/ highlights |
|---|---|---|---|
| Sri Lanka-<br>Dairy Development Project 1 | To provide credit and technical support for on-farm development of about 1,800 small to medium and 600 large-scale dairy farms in the Coconut Triangle (Kurunegala district included) and Mid-Country of the Wet Zone | Funder: World Bank<br>Duration: 1974-1979<br>Type of Fund: Loan (interest-free)<br>Fund amount:<br>Original value: US$9 million<br>PV*: US$ 54.65 million | - Lack of farmer motivation for development<br>- The government needs to have a quality-based pricing policy<br>- Government needs to take action to increase local cattle availability<br><br>World Bank (1974) |
| Sri Lanka-<br>Dairy Development Project 2 | To assist in the establishment of an organizational structure for the dairy industry (improve milk production, upgrade infrastructure) and to provide benefits to 180,000 farm families through on-farm employment. | Funder: World Bank<br>Duration: 1979-1986<br>Type of fund: Loan (with interest)<br>Fund amount:<br>Original value: US$ 38 million<br>PV*: UD$ 186.63 million<br>*(this project was not implemented)* | - The project funding was terminated because the government was unable to implement the expected changes in the pricing structure, raise consumer prices, secure foreign technical support for the management of dairy infrastructure, and propose a business plan for restructuring the dairy industry.<br><br>World Bank (1985) |
| New Zealand-funded dairy projects | Increase economic and food security benefits from agriculture<br><br>Phase II – 2745 dairy farmers trained in milk production<br><br>Phase III – Dairy extension training to 88 people (44 livestock development instructors and 39 veterinarians) | Funder: New Zealand Foreign Affairs and Trade<br><br>Phase 1 – Wanni dairy project (2012)<br>Phase II – 2016<br>Phase III – 2017<br>Phase IV –2021<br>(ongoing projects) | - Underscores the complexity of dairy development's impacts on sustainable livelihoods and the necessity of integrating local insights into development policy and practice<br><br>New Zealand Foreign Affairs and Trade (2021); Edwards (2020); Edwards (2021) |
| Market-Oriented Dairy (MOD) Project<br>(A pilot project) | To increase agricultural productivity and to expand the trade of milk and milk products in Sri Lanka. | Funder: Foreign Agricultural Service, United States Department of Agriculture<br>Duration: 2017-2024<br>Type of Fund: Grant<br>Fund amount:<br>Original value: US$27.6 million | - The project would use a more participatory approach. Rather than relying on advisors coming to producers on a regular basis, it is better if producers organize within a cluster to further explore and test improved methods when an advisor is not present. |

| | | | |
|---|---|---|---|
| | | | - Farmers need more training in farm management so they can be independent in recording information about money and product flow.<br>- The project would closely link with banks which will provide a good platform to provide loan facilities for farmers<br>- Milk processors may be involved in providing farmer training, follow-up visits, and on-site guidance.<br><br>Market-oriented dairy project (2018); Vyas et al. (2020) |
| Programs under the Sri Lanka Dairy Development Project | - Ugrade native herds (Import high yielding cows and establishment of breeder farms)<br>Sri Lanka Dairy Development Project (under this project high yielding cows imported from New Zealand and Australia in 2013, 2015, and 2017)<br><br>Commercial scale dairy development loan scheme<br><br>(under this project it was planned to provide loans to establish 1000 mega-farms)<br><br>- Farmer empowerment program (farmers and officers training)<br><br>Enterprise Sri Lanka loan scheme (Under this project loans were provided to empower farmer communities to alleviate poverty) | Funder: Sri Lanka government<br><br>Duration: On going projects | - Mega farm establishment was not practiced as planned<br>- Due to nutritional insufficiency, heat stress and diseases the mortality rate was high among the exotic cows they were below the expected/ potential milk yield and reproduction<br>- Projects have been implemented without a feasibility study for short-term gains rather for long-term benefits.<br><br>Vidanarachchi et al. (2019); Thenuwara Acharige (2022); Hitihamu (2022) |

**Note:** *PV= FV x $(1 + r)^n$ (PV= Present Value (amount in today's terms); FV= Future Value (original amount); $r$ = Annual inflation rate (assumed to be 3.6% on average); n = Number of years elapsed (from project-initiated date to year 2025))

# CHAPTER 2:
# LITERATURE REVIEW

## 2.1 Introduction

This chapter reviews three literature review domains—supplier development (SD), sustainability, and agrifood value chains (AVCs)—and the intersecting domains (Figure 2.1) to synthesize knowledge and identify knowledge gaps that the research aims to full, along with a conceptual model that will be used at the early stages of theory development to guide these stages. The narrative literature review approach—which is the traditional literature review approach—was used to search articles, as this approach allows in-depth exploration and flexibility (Baumeister & Leary, 1997; Green et al., 2006; Neuman, 2013). A range of keywords and more often keyword combinations, were used to search articles in Discover, Scopus, and Google Scholar article databases. The former was the default.

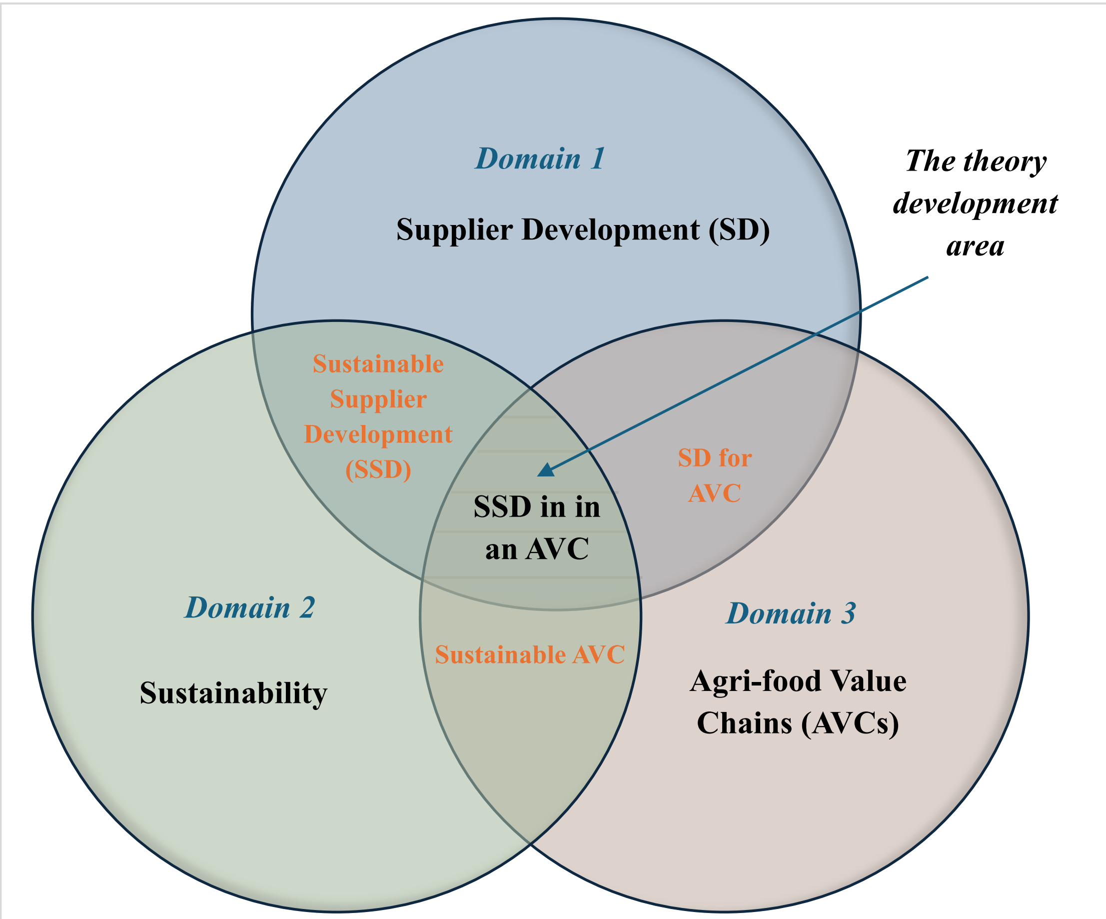


**Figure 2.1 Key domains of the literature review**
*(Source: Own work)*

The chapter is organized as follows: Section 2.2 reviews the literature on SD, synthesizing knowledge about the effectiveness of SD programs for both buyers and suppliers. Section 2.3 reviews the literature on sustainability, with a focus on sustainable development and sustainability reporting, particularly in relation to farmer development by the corporate sector within a buyer-supplier dyadic relationship. Section 2.4 explores the literature on AVCs, with specific attention to the dairy value chain (VC) of Sri Lanka, to understand its structure, governance, and value flow. Section 2.5 reviews overlapping areas, including sustainable supplier development (SSD) and SSD within AVCs. Section 2.6 identifies knowledge gaps, while Section 2.7 presents the initial conceptual framework to support theory development. Finally, Section 2.8 concludes the chapter by summarizing the key points.

## 2.2 Supplier Development (Domain 1)

Nearly 30 years ago, Krause (1997) defined SD as "any effort of a firm to increase performance and/or capabilities to meet the firm's short and/or long-term supply needs" (p.12). Through the literature synthesis summary (literature covering the past 17 years) presented at the end of this section, the researcher found that the above definition stands the test of time. The phrase "performance and/or capabilities" in the above definition refers to supplier's performance and/or capabilities, as evidenced from the statements that preceded the definition: "Thus to complete, firms must ensure that their suppliers' performance and capabilities are equal to or greater than the performance and capabilities of the firm's competitors" (Krause, 1997, p. 12). The phrase "any effort" in the above definition covers any initiative undertaken by the buyer to improve the performance and/or capabilities of their supplier—including developing the value-creating capability of the supplier—to achieve strategic operational outcomes for the buyer.

The history of SD as a supplier quality assurance approach dates to the period of World War I, and more so in World War II when quality issues were identified in the battlefield, such as non-exploding shells or inferior functionality of the battle tanks being supplied to the allied forces (Corinna, 2010; Leenders, 1966; Wagner, 2006). SD back then (the government played a vital role in technical assistance and financial support, as the buyer was the military) and SD now (primarily in the hands of a private enterprise) are different because quality management and operations management—the parent disciplines of SD—concepts have evolved over time; example, evolution from "inspection" by quality inspectors back in the day as the only quality control method to total quality management (TQM), lean, and lean six sigma (Dale et al., 2016;

Holweg, 2007; Zu et al., 2008). Much of the theory behind SD emerged during the quality era (the early 1980s through to the early 2000s), a period also referred to as the *dynamic engagement era* (Stoner et al., 2003) or the *total quality era* (Hackman & Wageman, 1995; Summers, 2018). As mentioned in chapter 1, quality advocate late Edward Deming—his 14 points on quality which have been influential for nearly 40 years— highlighted SD and supplier relations through his fourth point on quality and productivity improvement: "*End the practice of awarding business on the basis of price tag. Instead, minimize total cost. Move toward a single supplier for any one item, on a long-term relationship of loyalty and trust*" (Deming, 1986, p. 23). Deming's proposition emphasizes that by limiting the number of suppliers for a particular part to one (or very few) and fostering a long-term relationship with them, a firm can gain a competitive advantage—for example, by reducing both the buyer's and the supplier's costs associated with poor quality.

SD has also been associated with Toyota Motor Corporation since 1943 (Rajput et al., 2012) and the term coined in academia by Leenders (1966). The significant contributors to the topic of SD are Krause (e.g., Krause, 1997; Krause et al., 2007; Krause et al., 2000), followed by Wagner, Hahn, Handfield, and Humphreys (e.g., see Hahn et al., 1990; Handfield et al., 2000; Humphreys et al., 2004; Wagner, 2006). All these researchers and their contributing colleagues have emphasized the importance of SD and contributed to the body of knowledge on this subject over the years and new contributions are emerging in the sustainability domain as sustainable supplier development (SSD) (e.g., Bai & Satir, 2022; Carter et al., 2020; Jia et al., 2023). This subdomain will be covered in Section 2.5.2. In the literature, SD initiatives are often classified under two categories: direct initiatives and indirect initiatives (Krause & Ellram, 1997; Wagner, 2009; Yawar & Seuring, 2020). The researcher's own interpretation of these two categories is given at the end of this section.

### 2.2.1 Direct SD

Direct SD initiatives, also referred to as internalized SD or *a broad perspective of SD*, reflect an active role taken by the buying firm in enhancing supplier performance and capabilities through resource commitment (human, financial, and knowledge-based) (Benton et al., 2020; Krause et al., 2007). Wagner (2009) uses the concept of "asset specificity" from transaction cost theory (Williamson, 1979) and the knowledge-based view (Pemberton & Stonehouse, 2000) to explain direct SD undertaken by the buying firm. According to (Wagner, 2009), transaction cost theory suggests that in buyer-supplier relationships, SD investments are relationship-specific, adding value or reducing costs beyond what can be achieved through alternative approaches such as supplier switching or vertical integration. Asset specificity, in a SD context refers to the buying firm's investments in knowledge-specific resources (e.g., training the supplier by buyer's engineers who are stationed in supplier's facility) and capital-specific resources (e.g., machinery and tools) that have exclusive value for both parties (Grover & Malhotra, 2003). The knowledge-based view assert that knowledge is the most important inimitable strategic resource a firm possesses (Chen et al., 2015; Wagner, 2009); sharing the knowledge embedded in firms in a SD context occurs either within the supplier's firm or between the supplier's firm and the buying firm through SD programs that involve collaboration, observation, and adopting the buying firm's practices (Wagner, 2009).

In the early stage of SD evolution, the mode of SD was almost invariably direct SD with buying firms dealing with fewer suppliers and close relationships with them. However, when SCs became complex, the focus expanded to indirect SD where buyers wanted to have a scalable mechanism (something cost-effective and possible to have in a profit-oriented environment) to manage a larger number of suppliers, hence indirect SD came into the reckoning (Krause et al., 2000; Wagner, 2009).

### 2.2.2 Indirect SD

Indirect SD initiatives also referred to as externalized or narrow perspective of SD, take place when the buyer commits only very limited resources to improve the supplier's performance (Ghijsen et al., 2010). A buyer's indirect involvement in SD activity is often to: evaluate and provide feedback, conduct supplier performance benchmarking, give rewards for good performance, and set targets/goals, commonly linked to transactional relationships (Wagner, 2009; Zhang et al., 2017). Goal setting theory (Locke, 1968) emphasizes that setting specific and challenging goals, and providing performance feedback also leads to higher performance. Thus, indirect SD can be viewed through a goal theoretic lens.

Although direct and indirect SD are conceptually distinct and each aims to achieve two different objectives, and more importantly the key hypothetic-deductive study conducted by Wagner (2009) showed that the two approaches are antagonistic—based on the negative 'Direct SD'*'Indirect SD' two-way interaction on 'buyer performance' found in the regression model—it has been argued by some researchers that both approaches can work side-by-side in some situations, such as in complex SCs to achieve broader SD objectives (Carr & Kaynak, 2007; Krause & Ellram, 1997; Modi & Mabert, 2007). For example, indirect SD activities may set the foundation by identifying performance gaps, setting expectations, and fostering communication, while direct SD activities can then be used for more targeted interventions with key suppliers (Handfield & Bechtel, 2002; Krause, 1999; Wagner, 2009; Zhang et al., 2017).

### 2.2.3 The researcher's synthesis on the empirical research that cover the relationship between SD initiatives and supplier's performance and buyer's performance

The researcher reviewed all key research papers published during the past 17 years that tested the relationship between SD initiatives (cause/predictor) and supplier performance and/or buyer performance (effect/response), based on large sample data. Eight studies are summarized in Table 2.1 which also summarizes the findings of Yawar and Seuring (2020), which does not involve hypothesis testing. The study has been included in Table 2.1 because the study reconceptualizes the cause-and-effect relationships, and the second author is a leading author in SCM. The following are observed:

- o The specific SD initiatives vary from study to study. This means that it is not possible to use a ready-made scale (questionnaire) for similar future work.
- o Although the direct SD and indirect SD dichotomies are alive and well (not all the studies use this dichotomy), more pragmatically speaking, this distinction may not be important in some future hypothetic-deductive type studies because both direct SD and indirect SD act the same on the response, which is either supplier performance (SP) or the buyer performance (BP).
- o All SD studies relate to developing suppliers who supply parts or components to the buyer, for the buyer's manufacturing process.
- o Invariably, improvements in quality and delivery performance (operationalized in many ways) of both buyers and suppliers are hypothesized in the literature.
- o SD initiatives covered in some studies seem to be adaptable to a dairy VC in a developing country. For example, perhaps with the exception of the last SD initiative mentioned by Krause et al. (2007), namely supplier certification, the remainder—subject to fieldwork to ratify—seems to be appliable to a farmer-milk processor dyad in a developing country. Of course, the milk processor will not send their engineers to dairy farms, but they can send their extension officers to strategically important farms to train and educate the farmers.

- Structural equation modelling (SEM) and hierarchical regression analysis are the common data analytics tools that the researchers have used to test the hypothesized relationships.
- Not all studies have demonstrated a statistically significant relationship between supplier development initiatives (SDIs) and SP. For instance, Benton et al. (2020) who analyzed data from operations managers of automotive parts companies supplying Honda, Ford, Chrysler, and General Motors found no statistically significant direct relationship between SDIs (cause) and SP (effect). This highlights the importance of carefully scoping the researcher's study in the context of the Sri Lankan dairy industry.
- Finally, scholars who have conducted positivist research have stayed away from linking SDIs with supplier's TBL performance (or buyer's TBL performance) to test the link. It could because that in the studies covered, both suppliers and buyers have the capacity to launch their own sustainability programs and therefore SDIs have not been directly aimed at improving the TBL performance of the suppliers. In fact, the definition of SD does not cover sustainability in any direct way. It could also be possible that sustainability data are not readily available with supplier companies to test the relationship between SDIs and supplier's sustainable performance. Suppliers of agriculture produce in developing countries—the farmers—do not have the capacity to develop sustainability programs and improving farmer capacity through SD could benefit farmers in improving their TBL performance.

**Table 2.1 Theory testing involving supplier development initiatives, supplier performance, buyer performance, with the causal links**

| Author (Year) | Perspective/ unit of analysis | Supplier development initiatives (SDI) | Supplier performance (SP) measures used | Buyer's competitive performance (BP) measures used | Causal links *(Technique used to test the link/s)* |
|---|---|---|---|---|---|
| Nagati and Rebolledo (2013) | Suppliers | - Site visits by the buyer<br>- Buyer's site visit by the supplier<br>- Supplier training and education<br>- Joint work teams | - Product quality<br>- Delivery lead time<br>- Manufacturing flexibility<br>- Joint work teams | | SDI → SP<br>*(CB-SEM)* |
| Lee et al. (2018) | Suppliers | - Sharing buyer's implicit knowledge<br>- Supplier mentoring<br>- Supplier performance improvement focussed feedback | - Unit cost of manufacturing<br>- Flexibility to change volume<br>- Quality conformance<br>- Timely delivery | | SDI → SP<br>SOC → SP<br>*(PLS-SEM)* |
| Dalvi and Kant (2018) | Buyers | - Knowledge and information sharing<br>- Investment (training, transfer of personnel etc.)<br>- Working with the supplier (site visits, Joint problem solving etc.)<br>- Involvement of both parties | - Increased capacity and capability<br>- Decreased delivery lead time<br>- Increased supplier innovativeness<br>- Reduction of supplier inventory cost<br>- Improvement in delivery performance<br>- Increased order completion rate<br>- Improved material quality<br>- Increased supplier capacity<br>- Product reduction rate reduction<br>- % of meeting buyer expectation<br>- Reduction in total cost of manufacturing | - Reduction in total product cost<br>- Buyer's flexibility improvement<br>- Buyer's capacity improvement<br>- Increase in buyer's resilience<br>- Sales increase<br>- Increase in responsiveness<br>- Increased capability of manufacturing products<br>- Increased product quality<br>- Increase brand recognition<br>- Increased societal acceptance<br>- Increased business expansion<br>- Increased market share<br>- Increased new customer inquiries | SDI → SP<br>SDI→ BP<br>*(Hierarchical regression)* |
| Benton et al. (2020) | Suppliers | ***Direct SD Initiatives***<br>- Site visits by the buyer<br>- Invitations to the buyer's factory to show how the supplied product is being used<br>- Supplier training and education | - Product quality<br>- Delivery performance<br>- Price<br>- Responsiveness to requests for changes<br>- Supplier service support<br>- Overall performance | | Direct SDI → SP<br>Indirect SDI→ SP<br>BSR→ SP<br>*(CB-SEM)* |

| Author (Year) | Perspective/ unit of analysis | Supplier development initiatives (SDI) | Supplier performance (SP) measures used | Buyer's competitive performance (BP) measures used | Causal links *(Technique used to test the link/s)* |
|---|---|---|---|---|---|
| | | ***Indirect SD Initiatives (Incentives)***<br>- Promises of short-term benefits<br>- Promises of long-term benefits | | | |
| Wagner (2009) | Buyers | ***Direct SD Initiatives***<br>- Providing manufacturing advice<br>- Supplier training<br>- Transfer of buyer employees to supp.<br>- Providing product development advice<br>- Providing technological advice<br>- Providing quality-related advice<br>- Sharing buyer's implicit knowledge<br>- Sharing buyer's implicit knowledge<br>- Sharing buyer's implicit knowledge<br>- Sharing buyer's implicit knowledge<br>***Indirect SD Initiatives***<br>- Setting improvement targets<br>- Supplier auditing<br>- Supplier performance feedback<br>- Strong formal supplier evaluation | *Supplier Product Quality and Delivery (SPQD)*<br>- Product quality<br>- Product reliability<br>- Product replenishment lead time<br>- Delivery service quality<br>*Supplier Capability (SC)*<br>- Managerial capability<br>- Manufacturing capability<br>- Logistics capability<br>- Product development capability | | Direct SDI→ SP<br>Indirect SDI→ SP<br>Indirect SDI*Direct SDI→ SP<br>*(Hierarchical regression)* |
| Yawar and Seuring (2020) | Both buyers and suppliers<br>(a conceptual model only) | ***Direct SD Initiatives***<br>- Supplier training<br>- Supplier education<br>- Providing product development advice<br>- Investment of the supplier<br>- Supplier monitoring<br>- Knowledge transfer<br>***Indirect SD Initiatives***<br>- Supplier evaluation<br>- Supplier visits to buyer's site<br>- Supplier auditing<br>- Supplier certification for quality | Not mentioned | Not mentioned | Direct SDI→ BSR→ SP<br>Indirect SDI→ BSR→ SP<br>*(Structured literature review, and then, contingency analysis)* |

| Author (Year) | Perspective/ unit of analysis | Supplier development initiatives (SDI) | Supplier performance (SP) measures used | Buyer's competitive performance (BP) measures used | Causal links *(Technique used to test the link/s)* |
|---|---|---|---|---|---|
| Krause et al. (2007) | Buyer | ***Direct SD Initiatives (they called SD)***<br>- Allocation of staff to improve supplier's technical skills<br>- Regular visits by buyer's engineers to supplier's plant<br>***Indirect SD Initiatives (they called Supplier Evaluation)***<br>- Established dedicated SD team<br>- Supplier performance evaluation<br>- Supplier performance feedback<br>- Supplier certification for quality | | - Buyer's product quality<br>- Buyer's delivery performance<br>- Buyer's manufacturing flexibility<br>- Buyer's total cost of production | Direct SDI→BP<br>Indirect SDI→ BP<br>Length of relationship→ BP<br>Information sharing→ BP<br>Shared values→ BP<br>Buyer commitment→ BP<br>*(Hierarchical regression)* |
| Li et al. (2022) | Buyer | *Not relevant as SDI → SP (or BP) has not been covered* | | - Buyer's economic performance<br>- Buyer's innovation performance | Duration of BSR→ BP<br>Buyer-supplier Embeddedness → BP<br>Supplier external embeddedness → BP<br>*(CB-SEM)* |
| Li et al. (2012) | Buyer | - Increase supplier performance goals<br>- Supplier recognition and awards<br>- Supplier training in statistical process control<br>- Assigning staff to supplier's facilities<br>- Provide tools or equipment for supplier's process improvement<br>- Provide capital to the supplier for new investments to improve their operational performance<br>- Helping supplier to eliminate nonvalue adding activities (lean)<br>- Supplier involvement in buyer's product design and development | - Product design quality<br>- Product conformance quality<br>- Delivery performance (on time delivery)<br>- Price (reduced price without compromising quality)<br>- Inventory cost (lower inventory cost of the buyer for parts purchased)<br>- Delivery lead time for rush orders (reduced lead time)<br>- New product development lead time (reduced lead time) | - Increased product sales<br>- Reduced product cost<br>- Improved product quality<br>- Reduced turnaround time (increased service quality)<br>- Increased agility (responsiveness) | SDI→ Buyer competitive advantage<br>SP→ Buyer competitive advantage<br>SP→ Buyer competitive advantage<br>BSR→ Buyer competitive advantage<br>*(Path analysis in principal components regression form)* |

## 2.3 Sustainability (Domain 2)

No SCM theorist who subscribes to the stakeholder theory (Donaldson & Preston, 1995; Freeman et al., 2018) would dispute that, for long-term performance, a buying organization must create value not only for shareholders (the economic dimension of performance) but also for other stakeholders. Stakeholder theory holds that organizations have stakeholders—some more important than others—whose legitimate interests must be considered in strategy formulation and execution (Brown & Forster, 2013; Donaldson & Preston, 1995). Freeman (1984) to whom the ST is credited with, defined a stakeholder as "any group or individual who can affect or is affected by the achievement of the organization's objectives" (p. 46). In an AVC—an entity in its own right, having its major and minor stakeholders—in a buyer supplier context, farmers in a developing country could be a key stakeholder of a buying organization, such as a food processing organization (Chaturvedi et al., 2024; Lalwani et al., 2018; Yamoah et al., 2020). The buying organization can make a significant impact on the farmers, in terms of their economic and social wellbeing, positively or negatively, depending on what the organization's actions are (Lalwani et al., 2018; Mokoena et al., 2023). This leads to the concept of sustainability.

Scholars have highlighted that the concept of sustainability is hard to define as it encompasses three complex and interdependent domains—ecology, social wellbeing, and wealth creation—which results in viewing sustainability from a biased angle, depending on which of the three domains one valued most by the viewer (Feitelson & Stern, 2023; Ramsey, 2015; White, 2013). Although sustainability as a term emerged in 1930s in business literature, and is indeed a very broad topic now, it gained momentum only after the release of the United Nation's (UN) *Brundtland Report in 1987.* The Brundtland Commission was tasked with examining and recommending remedial actions on three key global development and environmental issues (Feitelson & Stern, 2023; Kuhlman & Farrington, 2010; World Commission on Environment and Development, 1987).[16] Arguably, the most important task was the first task: to "re-examine the critical issues of environment and development and to formulate innovative, concrete, and realistic action proposals to deal with them" (World Commission on Environment and Development, 1987, p. 356). Kuhlman and Farrington (2010) highlight that from a policy perspective, the Brundtland Report—officially titled, "Our Common Future"—addressed the

[16] More precisely, the *Brundtland Report was released by the* World Commission on Environment and Development, which was a sub-organization (dissolved after release of the report) of the UN, which was specifically tasked to cover three specific issues referred to in text.

tension between the “aspirations of mankind towards a better life on the one hand and the limitations imposed by nature on the other hand” (p. 3436).

An important outcome of the Brundtland Report is that it provided a working definition for ‘sustainable development’: *“meeting the needs of the present without compromising the ability of future generations to meet their own needs”* (World Commission on Environment and Development, 1987, p. 43).

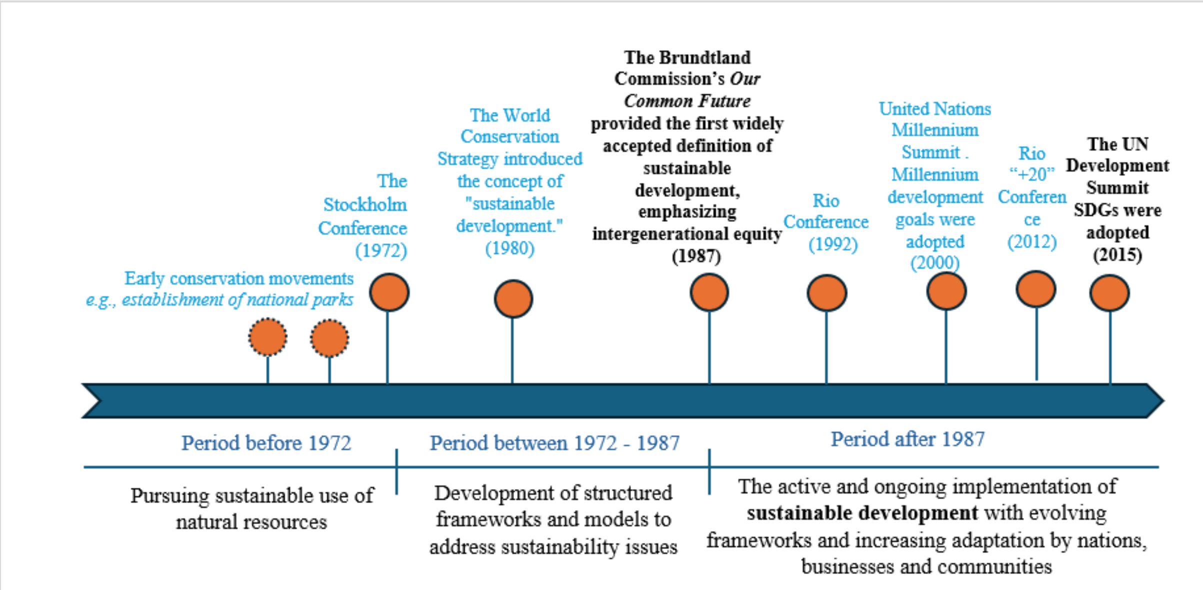


**Figure 2.2 The evolution of the concept of sustainable development**
*(Source: Own work)*

### 2.3.1 Sustainable development goals

To transform the working definition of ‘sustainable development’ (referred to in the Brundtland Report) into action, on 25 September 2015, the UN declared a resolution known as “the 2030 agenda for sustainable development”—known in short form as the Agenda 2030—which is a plan of action for “people, planet, and prosperity” (United Nations, 2015, p. 1). The agenda specifically states that “all countries, and all stakeholders, acting in collaborative partnership, will implement the plan” (United Nations, 2015, p. 1). The ‘Agenda 2030’ outlines 17 sustainable development goals (SDGs) (Table 2.2) reconciled against 169 targets for countries and stakeholders to pursue, in implementing the plan to achieve substantial progress by 2030.

The 17 SDGs which are “integrated and indivisible” are proposed to “balance the three dimensions of sustainable development: the economic, social, and environmental” (United Nations, 2015, p. 1). Thus, it can be argued that the UN readily recognizes Elkington’s triple bottom line framework on business accounting (Elkington, 1998) as a framework for understanding sustainability at a global level.

Since all countries and stakeholders are responsible for implementing policies and actions to achieve the 17 SDGs and their corresponding targets, seven SDGs become particularly relevant in the context of an AVC involving a buyer and its suppliers: SDG 1, SDG 2, SDG 3, SDG 4, SDG 5, SDG 8, and SDG 12 (justification via the literature is in the next section).

**Table 2.2 The UN's 17 Sustainable Development Goals**

| SDG Number | Heading | Targets to address |
|---|---|---|
| SDG1* | End poverty in all its forms everywhere | 7 |
| SDG2* | End hunger, achieve food security and improved nutrition and promote sustainable agriculture | 8 |
| SDG3* | Ensure healthy lives and promote well-being for all at all ages | 13 |
| SDG4* | Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all | 10 |
| SDG5* | Achieve gender equality and empower all women and girls | 9 |
| SDG6 | Ensure availability and sustainable management of water and sanitation for all | 8 |
| SDG7 | Ensure access to affordable, reliable, sustainable and modern energy for all | 5 |
| SDG8* | Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all | 12 |
| SDG9 | Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation | 8 |
| SDG10 | Reduce inequality within and among countries | 10 |
| SDG11 | Make cities and human settlements inclusive, safe, resilient and sustainable | 10 |
| SDG12* | Ensure sustainable consumption and production patterns | 11 |
| SDG13 | Take urgent action to combat climate change and its impacts | 5 |
| SDG14 | Conserve and sustainably use the oceans, seas and marine resources for sustainable development | 10 |
| SDG15 | Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation, and halt biodiversity loss | 12 |
| SDG16 | Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels | 12 |
| SDG17 | Strengthen the means of implementation and revitalize the global partnership for sustainable development | 19 |
| | **Total number of targets to address** | **169** |

* Denotes the seven SDGs that are highly relevant to the study, and will be covered and discussed in detail in Chapter 7

**Source:** United Nations (2015)

### 2.3.2 Corporate sustainability reporting

When buyers become focal companies in a SC with a sustainability focus, they are uniquely positioned to support their suppliers in achieving sustainable outcomes (Donovan et al., 2015), which is the rationale of SSD. A buying company such as a large milk processing company in a developing country that is actively developing its farmers (especially smallholder farmers) to achieve Triple Bottom Line (TBL) outcomes can highlight this as part of its sustainability reporting. Corporate sustainability reporting refers to the process by which organizations measure, disclose, and communicate their commitment to sustainable practices and impact on their stakeholders (Shaikh & Tripathy, 2025). Sustainability reporting has evolved from being a discretionary practice of sharing an organization's contributions to society to becoming an essential component of corporate accountability (Kassier, 2024; Shi et al., 2019).

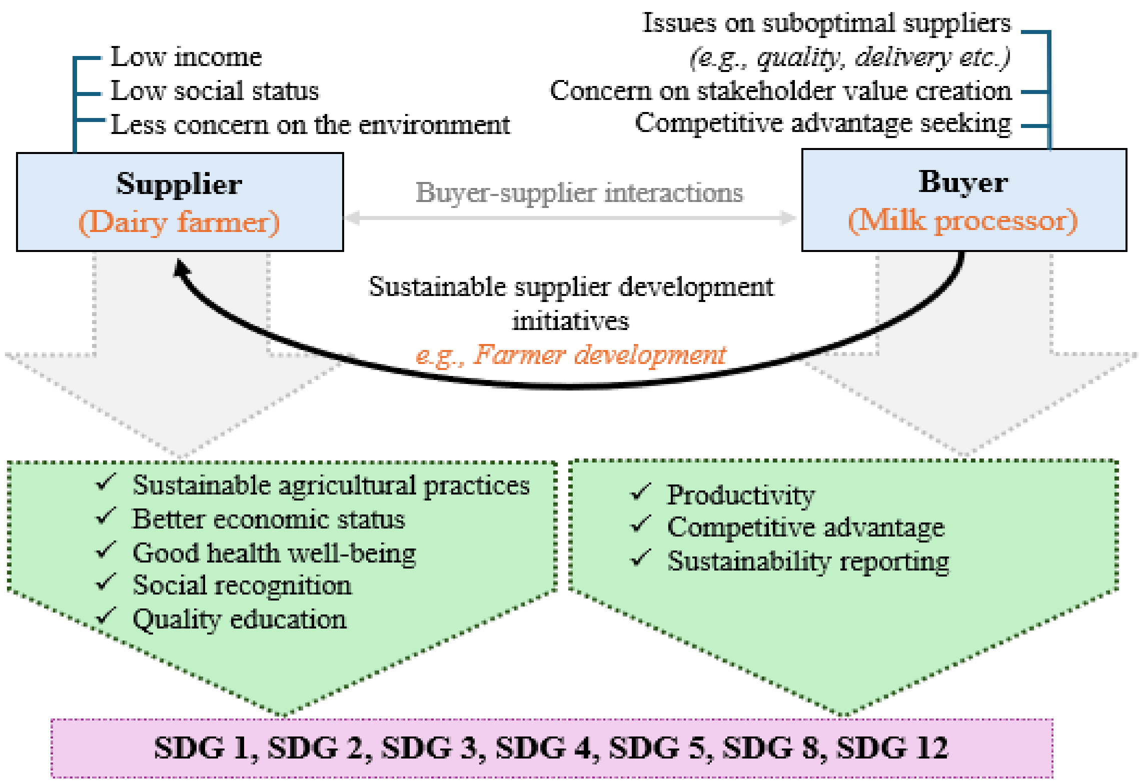


**Figure 2.3 Aligning SSD in an AVC with the SDGs in a developing country context**
*(Source: Own work)*

Figure 2.3 depicts the researcher's synthesis on aligning SSD in an AVC with the SDGs in a developing country context. Since majority of the dairy farmers in developing countries receive a low-income, farmer development initiatives such as financial support programs (e.g., loans to improve dairy business, timely payment, and better prices for high-quality-milk) can uplift farmers economically and help reduce poverty (SDG1) (Terlau et al., 2019; Venkatesan et al., 2023). Improved farming practices through farmer training (e.g., training on milk production) can enhance milk production and quality, thereby contributing to national food security and nutrition (SDG2) (Nozaki et al., 2023; Pandey et al., 2024). Promoting health and safety practices at the farm level (e.g., training on animal health and care), and improving the well-being of farmers (e.g., higher income from improved farm performance can improve access to healthcare for farming communities) align well with SDG 3 (Pandey et al., 2024). Farmer training that includes sustainable farming practices can enhance farmers' knowledge and skills, a key aspect of farmer education. Additionally, this improved knowledge can create opportunities for farmers' children to access quality education (SDG 4). Opening more opportunities for women to participate in training programs, credit access and achieve equal opportunities in farm business promotes gender equity (SDG 5) (Agarwal, 2018). Recognition from society for farm business, fosters decent livelihood for farmers (SDG 8). Encouraging sustainable farming practices (e.g. training on sustainable farming practices) aligns with the concept of 'sustainable consumption and production' (SDG 12) (Verma et al., 2025).

Globally recognized frameworks such as the Global Reporting Initiative (GRI), Sustainability Accounting Standards Board (SASB), and Task Force on Climate-related Financial Disclosures (TCFD) provide guidelines for corporate sustainability reporting (Kassier, 2024; Shaikh & Tripathy, 2025). These frameworks encourage companies to align their operations with the SDGs, fostering accountability and transparency. Within AVC, its key stakeholders—farmers (as a collective), food processing companies, distribution channels, and consumer groups—can use these frameworks to leverage on demonstrating how their sustainability practices contribute towards sustainability.

## 2.4 Agri-food Value Chains (Domain 3)

An AVC is a specific type of value chain (VC). As such, the literature on the conceptualization of a VC is reviewed first.

### 2.4.1 Value chains: From Poter's initial conceptualization to the Service-Dominant Logic

Michael Porter (1985) introduced the concept of the VC as a strategic management framework to explain how a firm creates value—the total financial worth of a product to the customer relative to the cost of creating it through the firm's interconnected processes and activities—to achieve a competitive advantage in the market. The primary aim of defining and explaining a VC was to enhance understanding of how a firm's activities (see Figure 2.4) can be improved to strengthen the firm's “cost position” and gain a competitive advantage (Porter, 2008; Teece, 2007; Williamson, 1979). An important aspect of Porter’s VC is the distinction between a firm’s primary activities (value-creating activities) and support activities (those necessary for the efficient functioning of value-creating activities). This distinction helps to understand how these processes interact and how a firm can continuously improve its activities to sustain a competitive advantage, given the *attractiveness of the industry* in which a firm operates (Porter, 2008; Reda & Dvivedi, 2022; Francesco Ricciotti, 2020).

Having defined a firm’s VC, Porter (1985) went on to apply his concept to the upstream and downstream actors connected with the firm’s SC in a liner fashion—upstream: the VC of the firm’s supplier, the VC of the firm’s supplier’s supplier, and so on; downstream: the VC of the channel, and the VC of the buyer—to explain the entirety of the firms’ VC processes. The massive expansion of globalization of trade—since Portor’s definition of the VC in 1985—resulting in SCs being transformed into supply networks means that in the 21st century, Porter’s linear VC thinking has transformed into value networks (Mangan et al., 2021; Ricciotti, 2020: Lusch and Vargo, 2006). As a result, individual entities in the value flow are being viewed as nodes in a larger value network (Francesco Ricciotti, 2020; Simatupang et al., 2017).

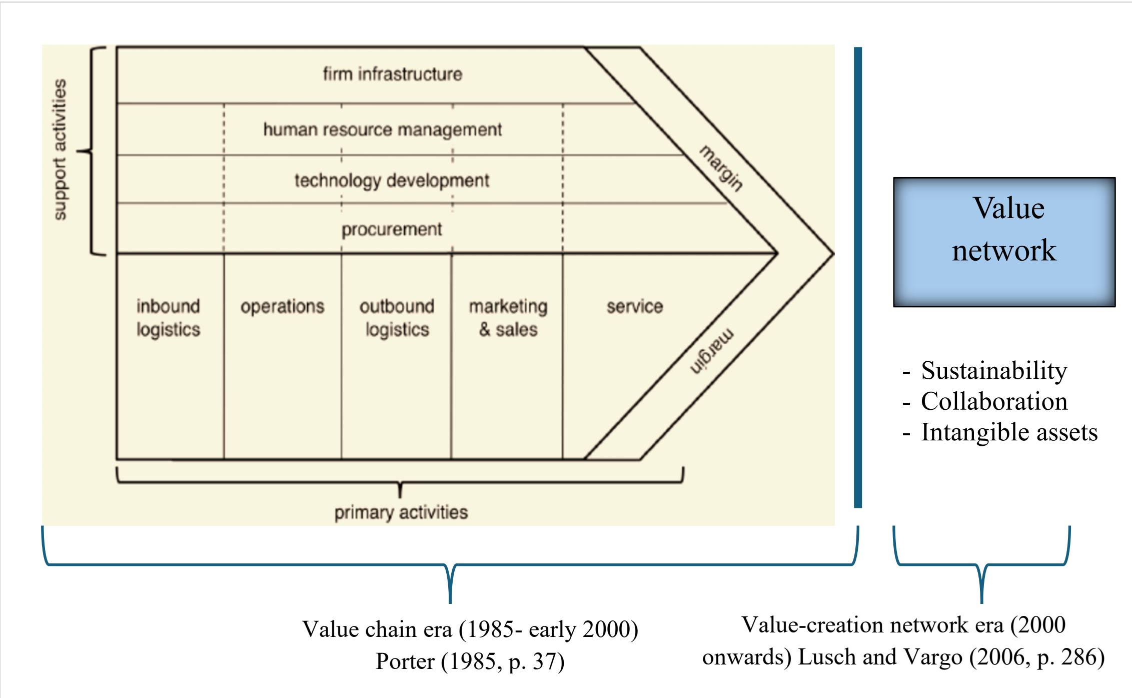


**Figure 2.4 Transformation of VC**

(Source: Own work)

A VC is different to an SC in that VC thinking emphasizes maximizing the value capture in monitory terms (through optimizing the design of the value chain/network) (Feller et al., 2006; Holweg & Helo, 2014; Villela, 2014), whereas SC thinking emphasizes maximizing SC efficiency by optimizing the flow (through optimizing the interconnected process within the SC) (Eltantawy et al., 2015; Holweg & Helo, 2014; Mangan et al., 2021; Schmenner & Swink, 1998). Thus, both VC and SC are complementary and as a SC researcher, for the purpose of her present research, the two terms are used interchangeably.

VC thinking has recently shifted from a goods-dominant logic, as implied in Porter's proposition of value creation—focus on making a good product by efficiently and effectively managing the firm's primary activities (e.g., adding features cost-effectively to enhance appeal), and shipping it to customers to generate profit—toward a service-dominant logic (S-D logic). Vargo and Lusch (2004) who advanced the S-D logic argued that goods do not possess inherent value. A firm (e.g., a manufacturer) cannot "embed" value into a product through the production process and then transfer it to the customer. Instead, a firm can only offer a value proposition; value is always co-created in the process of serving, where one party (e.g., a supplier) uses its capabilities to benefit another party (e.g., a processor). According to Vargo and Lusch (2016), S-D logic can be best summarized through five axioms: (i) service as the basis of exchange, (ii) value co-creation by multiple actors, (iii) all actors as resource integrators, (iv) the customer (or beneficiary) as a co-creator of value, and (v) value co-creation coordinated through actor-generated institutions and institutional arrangements. Consequently, the S-D logic adopts a macro-level (inside-out) view of service exchange, expanding VCs into value networks and integrating system thinking into S-D Logic (Jaakkola et al., 2024). According to Vargo and Lusch (2016), axiom (iii) suggests that all economic and social actors (e.g., firms, nonprofit organizations, individuals, families, society) are resource integrators. This advancement of VC urges organizations to consider the needs of its key stakeholders—especially suppliers, customers, and communities—to optimize the firm's long-term value apart from its internal value creation process (Christiansen, 2014; Jabnoun, 2019; Porter & Kramer, 2011, 2019). The researcher argues that if a VC is basic—such as Sri Lanka's fresh milk VC—or if the research focus is limited to the buyer-supplier dyad, the S-D Logic is unlikely to play a role in theory formulation or in the discussion of test results.

### 2.4.2 Extending the VC conceptualization to AVCs

The VC concept is particularly relevant in the context of the agri-food sector, where the focus is on how value is created and delivered from farm to the customer. The AVC involves a complex network of stakeholders, including farmers, processors, distributors, retailers, and consumers. It emphasizes the importance of food safety, quality, and sustainability throughout the entire chain, from agricultural production to final consumption (Cucagna & Goldsmith, 2018; Trienekens, 2011). In agriculture, the primary VC activities include farming, processing, and distribution, while support activities involve research, quality control, and supply chain management (Kaplinsky & Morris, 2000; Mac Clay & Feeney, 2019; Trienekens, 2011). Among the multiple definitions of an AVC available from different perspectives, the researcher uses the definition proposed by Neven (2014), who used a sustainability lens to define an AVC (Luo et al., 2018; Zhu et al., 2018) and will be covered later.

### 2.4.3 VC analysis

VC analysis a concept that can be used to identify opportunities for value creation through VC development (Howieson et al., 2016; Mac Clay & Feeney, 2019; Taylor, 2005; Touboulic & Walker, 2015). Basically, a VC analysis covers the *network structure*, *governance form*, and the *value addition* that occurs at different stages of value creation (Hidayati et al., 2021, 2023; Tray et al., 2021; Trienekens, 2011). These three elements of VC analysis are covered as follows:

The network structure in VC analysis refers to both the horizontal structure—the connectedness or collaboration of actors at the same level in the VC, which in an AVC context can mean the connectedness or collaboration between the farmers for example—and the vertical structure, which is the connectedness between actors at different levels of the VC, which in an AVC context can mean the connectedness or collaboration between the buyer and the farmer (Lazzarini et al., 2001; Widadie et al., 2021). VC governance refers to the system of coordination and control processes that regulate how activities and relationships among actors are structured and managed within the VC (Mishra & Dey, 2018; Trienekens, 2011). It determines who holds power in the chain, who makes key decisions, and how resources and benefits are distributed among the actors. VC actors in an AVC are the individuals or entities involved in the various stages of the agricultural process (Hidayati et al., 2021; Hitihamu et al., 2021; Tadesse, 2016). Governance also contains information flow where efficient information flow between the farmer and processor enabling better traceability and performance improvement (Mac Clay & Feeney, 2019; Trienekens, 2011). The value addition within a VC can happen at different stages by different actors (Trienekens, 2011). The stages of agri-food value-adding activities include farm production, processing, and delivery to customers (Cucagna & Goldsmith, 2018; Mac Clay & Feeney, 2019) and for example, in a dairy VC, the value addition can happen at the farmer stage (farm production stage) and also heavily at the processor stage (processing stage) (Nguyen et al., 2018; Rahman et al., 2019). The key elements in value addition in agri-food can be specified as quality, safety, and value orientation (Hidayati et al., 2021). However, the size of the value being added is decided finally by the end customer's willingness to pay for the value offering (Jayasena et al., 2020; Walter et al., 2001; Woodruff, 1997).

### 2.4.4 Dairy VCs in developing countries

Within the agri-food sector, a dairy VC is a critical subset that deals specifically with the production, processing, distribution, and consumption of dairy products (Barkema et al., 2015). Dairy products are packed with macronutrients and the industry plays a vital role in a developing economy in fighting hunger, poverty, gender equity and other SDGs (Barkema et al., 2015; FAO; Nadeem & Ahmad, 2024). Consequently, a dairy VC in a developing economy plays a vital role in delivering high-quality dairy products to consumers while ensuring that all stakeholders, from smallholder farmers to large-scale processors, contribute to and benefit from the value being created and exchanged. Apart from inherent characteristics of a dairy VC (an AVC in general) such as perishability, short shelf life, high waste generation, quality variability, vulnerability to seasonality and natural events (Joshi et al., 2023; Weerabahu et al., 2022), a dairy VC in a developing economy faces unique challenges, such as maintaining cold chains to ensure product quality, and integrating technological innovations to improve dairy farming and processing (Beber et al., 2019; Nadeem & Ahmad, 2024; Susanty et al., 2018).

Unlike the dairy industry in developed countries—more specifically, in North America, Europe, and Australasia—the dairy industry in developing countries is inefficient (Damunupola et al., 2022; Kajananthan & Achchuthan, 2012; Nguyen et al., 2018). For instance, a study on Kenyan dairy industry showed that the dairy sector suffers from significant inefficiencies due to poor infrastructure, limited access to modern farming technologies, and a lack of cold chain facilities, leading to high post-farmgate losses (Kiambi et al., 2018). In relation to the Indian dairy industry, Yawar and Kauppi (2018) showed the importance of socially responsible supplier development programs to upgrade India's dairy SC to become more efficient. A study on the Indonesian dairy industry revealed that targeted SSD initiatives, such as the introduction of cooling facilities, proper transportation, introduction of hazard analysis and critical control point (HACCP) and related food safety and quality controls improve both farmer's TBL performance and also, the relationship between farmer and milk processor (Susanty et al., 2018).

Another prominent feature of diary VCs in developing countries related to VC inefficiency, is the prevalence of a significant informal sector; depending on the country and region, a large portion of milk may be distributed through informal channels that lack accountability, quality control, and safety measures (Kiambi et al., 2018; Korale-Gedara et al., 2023). Another factor that contributes to low VC efficacy compared to that of developed countries is the lack of intensification (Dethier & Effenberger, 2012; Pretty, 2018). Literature highlights that these inefficiencies are prominent in upstream operations involving smallholder farmers (Birthal et al., 2017; Jayasena et al., 2020; Nguyen et al., 2018; Nyokabi et al., 2018). The inefficiencies in dairy VCs in developing countries highlight the necessity of adopting strategies and policies to cater to the unique conditions of developing countries, where traditional approaches may not be sufficient. Hence, addressing these multifaceted challenges requires comprehensive strategies that encompass infrastructure investment, financial access, technological adoption, policy reform, improved market integration, and support services targeting the weakest (De Silva et al., 2023; Hidayati et al., 2023; Hitihamu et al., 2021; Khairallah et al., 2023; Trienekens, 2011).

Milk and other dairy products are highly perishable, meaning they have a short shelf life requiring the products be stored under controlled ambient conditions to maintain safety and quality. The short shelf life, high wastage, quality variability, and the yield vulnerability to seasonality and natural events are some of the unique challenges perishable AVCs such as dairy VCs face, compared to non-perishable goods VCs (non-agricultural VCs) (Joshi et al., 2023; Susanty et al., 2019; Trienekens, 2011). This contrast—AVCs versus non-perishable goods VCs—is further amplified in developing countries due to reasons such as limited infrastructure, less availability of technology, financial constraints, market access problems, regulatory constraints, socioeconomic issues, logistical barriers, lack of support services and long fragmented SCs married by the pervasiveness of informal channels (Hidayati et al., 2021; Khairallah et al., 2023; Tricarico et al., 2020; Trienekens, 2011).

Limited infrastructure including poor transportation networks and inadequate storage facilities, exacerbates post-harvest losses and complicates market access (Trienekens, 2011). Technological constraints such as reliance on outdated farming practices and restricted access to modern agricultural tools, further impede productivity (Hidayati et al., 2021). Financial barriers, including limited access to credit and high input costs, constrain smallholder farmers' ability to invest in improvements (Balana & Oyeyemi, 2022; De Silva & Sandika, 2012). Market access issues, such as insufficient market information and weak linkages, prevent farmers from obtaining fair prices for their produce (Nguyen et al., 2018). Regulatory and policy inconsistencies create uncertainty, while environmental challenges, such as climate change and resource degradation, threaten agricultural output. Social and economic issues, including widespread poverty and limited education and training opportunities, restrict the adoption of new practices (De Silva & Sandika, 2012; Kataike et al., 2018). Logistical inefficiencies and fragmented SCs often lead to increased costs, poor quality and delays (Trienekens, 2011). Therefore, ensuring food safety and quality is problematic due to compliance difficulties and the prevalence of informal markets (Korale-Gedara et al., 2023). Importantly, a lack of support services, such as agricultural extension and research and development, hampers innovation and capacity building. These challenges often hinder the efficiency, productivity, and sustainability of AVC development (Mac Clay & Feeney, 2019) and the unpalatable reality is that these adverse SC characteristics and challenges often negatively impact the parties along the SC, especially smallholder farmers, making them the most vulnerable and loss-prone group (Hidayati et al., 2021; Kilelu et al., 2017; Susanty et al., 2018).

In contrast to above, developed countries typically have advanced infrastructure for agriculture (including dairy), modern irrigation systems, efficient transportation networks, and state-of-the-art processing facilities. They often employ advanced agricultural technologies such as precision farming, automation, and genetically modified crops and animals (e.g., artificial insemination for cows in dairy) to enhance productivity and reduce resource use. Developed countries also have better access to global markets and can export agricultural products more easily due to well-established trade relationships and compliance with international standards (Cammarata et al., 2021; Trienekens, 2011). Their efficient SCs minimize post-harvest losses and ensure product quality. Governments in developed countries often provide substantial support to their agricultural sectors, including subsidies, research and development, and regulatory frameworks that promote stability. These countries are more likely to have strict environmental regulations and sustainable farming practices, including organic farming and reduced pesticide use. On this basis, the challenges faced by agri-food SCs in developing countries may not be present or are less significant in developed country SCs. Therefore, it can be well argued that perishable goods VCs in developing countries often require modifications to strategies that work well in developed countries.

The value adding actors in a dairy VC in a developing country could be dairy farmers, farmer collectives[17], milk collectors, milk processors, distributors/wholesalers, and retailers (Kajananthan & Achchuthan, 2012; Nguyen et al., 2018; Nyokabi et al., 2018). Apart from these value adding actors, there can be service providers (e.g., veterinary services, feed suppliers, equipment manufacturers, transportation services, and others that support dairy farming and processing operations) and regulatory bodies (e.g., government authorities, standard boards) that provide support services. In a dairy VC, the initial value adding actor is the dairy farmer, although in many developing countries the milk processor and the intermediaries are also involved in significant value addition (Haq, 2012; Royer & Simon, 2023). These actors collaborate and interact within the VC to create value, deliver products or services to customers, and generate revenue and profits. However, their role or level of involvement could vary from context to context due to the scope and scale of the business, market structure, SC integration, and the policy framework. Hence, who becomes the key actor–who holds the power, how resources and benefits distribute among the actors– becomes context specific (Mac Clay & Feeney, 2019; Mishra & Dey, 2018; Seuring & Müller, 2008; Trienekens, 2011).

#### *2.4.4.1 Studies on the dairy VCs of Sri Lanka*

To isolate studies that cover the network structure, governance form, and value addition—the three elements of VC analysis—all studies that cover the dairy VC of Sri Lanka that were published since 2010 (more precisely from 2010 to 20 December 2024) were reviewed. 17 articles were found (Figure 2.5), of which only three covered either the network structure, governance, value addition, or a combination of two or more of the elements. The findings of four articles, in terms of the coverage of the three elements of VC analysis, are summarized in Table 2.3.

[17] These may be farmer corporative, farmer managed societies and so forth.

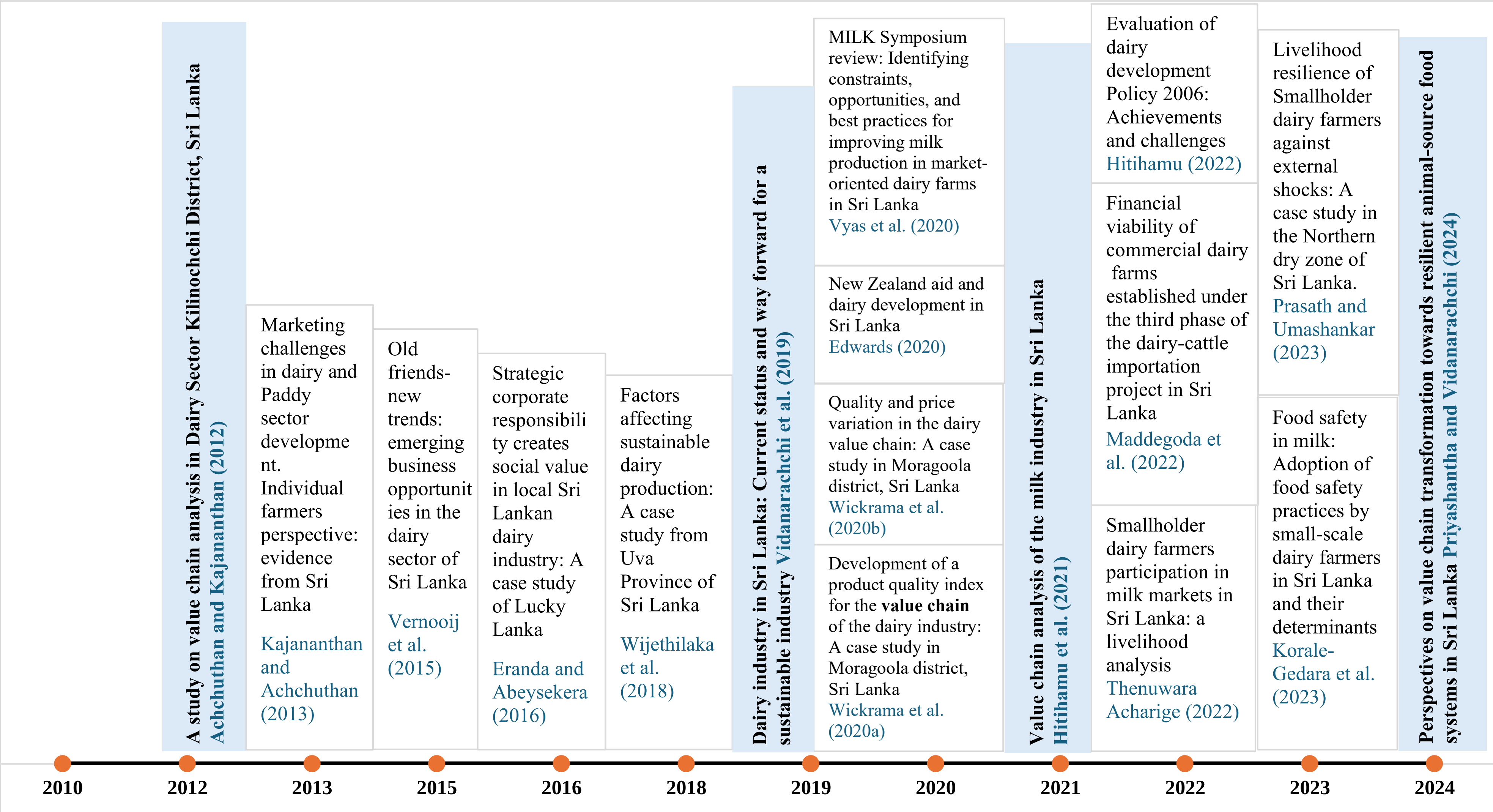


**Figure 2.5 Articles on the dairy VC of Sri Lanka published since 2010**

*(Source: Own work)*

Based on the four articles reviewed, it can be concluded that sufficient details on the network structure, governance, and value flow of Sri Lanka's dairy VC are lacking. This gap hinders understanding of the buyer-supplier dyad, including whether the buyer holds a position of strength to develop the supplier and whether SD is currently occurring to any notable extent. Because of this knowledge gap, it is challenging to present a framework on SD and test it using Sri Lanka's dairy VC as the research context. The understanding—to be ratified or suitably modified via fieldwork—is that SD is taking place in the agrifood VC of Sri Lanka to a level that is statistically detectable with a large sample, and it is the milk-processing companies who are developing the farmers as the buyers of farmer's produce.

**Table 2.3 Studies on the dairy VC of Sri Lanka**

| **Author/Year** | **The main purpose of the study** | **Shortcomings, from the point of view of the researcher's study** | | |
|---|---|---|---|---|
| | | Network structure | Governance | Value flow |
| Achchuthan and Kajananthan (2012) | To conduct a VC analysis of the dairy sector in Kilinochchi district, Sri Lanka | LC | NC | LC |
| Hitihamu et al. (2021) | To provide insights into the functioning of the dairy VC in Sri Lanka, highlight existing challenges, and suggest actionable recommendations for improving the industry's performance | LC | LC | LC |
| Vidanarachchi et al. (2019) | To assess the current state of the dairy industry in Sri Lanka and propose strategies for its sustainability. | LC | NC | LC |
| Priyashantha and Vidanarachchi (2024) | To provide insights into the livestock industry in Sri Lanka and its ability to adapt to evolving circumstances | NC | LC | LC |
| **Note:** LC – Limited coverage; NC – Not covered; C - Covered | | | | |

## 2.5 Reviewing the literature on the intersecting domains

### 2.5.1 Sustainable AVCs (Sustainability ∩ AVC)

In the current milieu, sustainable practices in agriculture not only address environmental and resource challenges but these also address the challenges in creating robust systems that enhance food security, rural livelihoods, and market resilience—especially in developing countries, where agriculture plays a pivotal role in economic and social stability (Cao & Solangi, 2023; Laurett et al., 2021). Embracing sustainable AVCs is thus increasingly crucial in ensuring that developing nations can meet current food demands while preserving resources for future generations (Chand et al., 2015; Syahruddin & Kalchschmidt, 2011). The integration of sustainability into agri-food literature became more prominent in the early 2000s, spurred by the growing interest in sustainable supply chain management. Neven (2014) defined a sustainable AVC as:

> *The full range of farms and firms and the successive coordinated value-adding activities that produce particular raw agricultural materials and transform them into particular food products that are sold to final consumers and disposed of after use, in a manner that is profitable throughout, have broad-based benefits for society and does not permanently deplete natural resources* (p. 06).

Sustainable AVCs encompass systems designed to balance economic viability, social responsibility, and environmental sustainability; developing countries, however, face significant barriers to realizing these sustainability goals within their AVCs (Hidayati et al., 2023). For instance, in a dairy VC in particular, poor physical infrastructure (cold chain transportation, storage facility and telecommunication), weak institutional infrastructure (support from government and other related institutions), limited access to resources (lack of know-how, financial support, inputs and support services), and unbalanced trade relationships (heavy dependency on intermediaries and opportunistic behaviors of buyers) (Hitihamu & Karunarathna, 2022; Khairallah et al., 2023; Trienekens, 2011; Wijethilaka et al., 2018) often restrict the ability of farmers and other stakeholders to fully integrate sustainable practices. These often cause inefficiencies or vulnerabilities along the AVC, negatively affecting the weakest actor the most, and resulting in low performance at the farm level (Hidayati et al., 2023; Jayasena et al., 2020; Nguyen et al., 2018). These constraints highlight the need for a strategic and systemic approach to support the weakest actor–farmers to adopt sustainable practices. However, who should initiate these strategies is the next best question to answer.

Although several agents can be involved in developing farmers in a developing country, the role played by the central government is of utmost importance, as it is the government that sets policies, offer funding and subsidies (e.g., vaccines, cattle breeds, and animal welfare), extension services, research, and development (Ganguly et al., 2022; Tang et al., 2019). Apart from the government, in a free-market economy other parties such as non-governmental organizations (NGOs), international development organizations (e.g., UN Food and Agriculture Organization (FAO) and World Bank), dairy cooperatives, financial institutions (e.g., Microfinance institutions and banks), private sector companies (e.g., processors), related academic and research institutions can also involve in farmer development (Joshi et al., 2023; Khairallah et al., 2023; Yawar & Seuring, 2018). For instance, in countries like Nepal and Bangladesh, dairy cooperatives and NGOs play a significant role in supporting farmers. In India, a farmer corporative such as Amul has a cooperative governance model that empowers smallholder farmers while ensuring efficiency in milk processing and marketing (Jha & Gupta, 2020).

**2.5.2 Sustainable supplier development (SD ∩ Sustainability)**

SSD refers to *any effort* taken by a buyer to improve two or more elements of their supplier's TBL outcomes (Ağan et al., 2016; Bai & Satir, 2022; Jia et al., 2021; Yawar & Seuring, 2018). Based on the current understanding of the concept of SSD, the researcher questions whether evidence of SSD hinges on: (i) the buyer's efforts to improve two or more aspects of their supplier's TBL outcomes, or (ii) the supplier's ability to improve two or more aspects of their TBL outcomes as a result of the buyer's efforts to facilitate such improvement. The researcher argues that the proof is in the latter!

Four empirical studies were found in the literature—unfortunately none related to AVCs—that examined the relationship between SSD initiatives and supplier's performance. These are reviewed as follows:

Through data collected from a sample of Chinese manufacturing firms serving as suppliers ($n$ = 129), Sancha et al. (2019) examined the extent to which a supplier's financial performance (SFP) is impacted by: (i) buyer-supplier collaboration for aiming supplier sustainability (BSCASS); and (ii) supplier being assessed by the buyer on supplier's sustainability practices

(SBABSSP). Multiple regression analysis was used to test the hypothesized relationships. For the BSCASS→SFP relationship, a positive effect was hypothesized while for the SBABSSP→SFP relationship, a negative effect was hypothesized, primarily on the grounds that the supplier's cost structure increases when the buyer is monitoring their (suppliers') sustainability practices. In addition, they studied the extent to which *supplier dependence* moderates the BSCASS→SFP and SBABSSP→SFP relationships (positive moderation effects for both relationships were hypothesized). Data partially supported the hypotheses (some were supported, and some were not supported). Sancha et al. (2019) conduced that suppliers could leverage on buyer-supplier collaboration and supplier dependence to improve supplier's financial performance. Since only supplier's financial performance was included as the response variable, it can be concluded that this empirical study did not provide any empirical evidence of SSD occurring.

Through data collected from a sample of Chinese manufacturing firms occupying the position of buyers in SC ($n$ = 256), among other hypotheses, Yang and Zhang (2017), tested three hypotheses which posited that *sustainable supplier development initiatives* (SSDI) have a positive effect on: (i) supplier performance (SP); (ii) buyer-supplier relationship (BSR); and, (iii) buyer's competitive advantage (BCA). Firm size and 'firm's investment on sustainability' were used as control variables, while the Likert-type statements in the questionnaire directed to the buying firms referred to the main supplier. PLS-SEM was used as the statistical technique to test the hypotheses. Of the three hypotheses under contention—SSDI→SP, SSDI→BSR, (iii) SSDI→BCA—only the first one was supported by the data. The two control variables were found to have no effect on the three response variables (i.e., SP, BSR, and BCA). While it is interesting to know that a buyer's SSDI had a positive effect on SP, the study did not provide any evidence of buyer's SSD efforts resulting in improving supplier's TBL performance on two accounts. First and foremost, the operational definition of the response variable SP did not contain any measure that captured supplier's social performance or environmental performance (the five measures used to operationalize SP were: % of orders meeting quality requirements, cost of purchased parts, delivery speed, production flexibility, and the corporate reputation). Second, the operational definition of the predictor variable SSDI remained questionable as the five measures used to operationalize SSDI—providing technical support, training on overcoming sustainability issues, providing feedback on sustainability performance, offering suggestions to improve production targets, supporting to improve process capability—only vaguely captures buyer's initiatives concerning supplier's sustainable production. Everything depends on what the respondents interpret as "sustainability".

Through data collected from a sample of Spanish manufacturing firms occupying the position of buyers in SC ($n$ = 120), C. Sancha et al. (2015), tested two main hypotheses which posited that *socially oriented supplier development practices* (SSDP) have a direct positive effect on: (i) buyer's operational performance (BOP); and (ii) buyer's economic performance (BEP). In addition, they tested mediation hypotheses which posited that the SSDP→BOP and SSDP→BEP relationships are being mediated by the supplier's social performance (SSP). Firm size was used as a control variable. Path analysis, in the form of principal components regression, was used as the statistical technique to test the hypotheses. Of the hypotheses tested two returned unexpected results: SSDP was found to have a negative direct effect on BEP; (ii) SSP was not found to be acting as a mediator in the SSDP→BEP relationship. However, SSDP was found to be positively impacting SSP, which implied that *socially oriented supplier development practices* benefit the supplier in developing their social outcomes. However, the researcher questions the validity of this particular result reported by Sancha et al. (2015) on grounds that the operational definition of SSDP covered only standard measures used for operationalizing SD (e.g. feedback on supplier performance, performing audits on the supplier's internal management system, visiting supplier's facilities to help them to improve performance, etc.). It could be argued that through factory visits and audits conducted by the buyers, they did examine their suppliers' social performance, not just their product quality performance and process capability. In any case, from a supplier's perspective, the study only examined the impact of SD on suppliers' social performance (operationalized via human rights compliance, no child labor compliance, and factory working conditions).

Using the case study methodology involving 41 supplier companies, 9 buyer companies, and 13 other contributors (researchers, consultants, NGOs on sustainability), Liu et al. (2018) found that SD practices for sustainability work best—*impactful environmental performance results*, and energy saving, and *compliance in social sustainability,* such as occupational safety and health—when facilitators (driver 1) and inspectors (driver 2) are being deployed in the SC, and works worst when both drivers are not present. They also found the presence of one driver also brings some benefits to the supplier. The study is useful, as contains rich information synthesized from semi-structured interviews, but the propositions need to be tested with quantitative data for generalizability. In addition, the impacts can be quantified when quantitative data is available.

Using agency theory as their theoretical lens to align with a socially responsible governance system suitable for the Bangladeshi apparel manufacturing context, Yadlapalli et al. (2018) theorized that supplier selection (SupS) positively affects suppliers' economic sustainability (ES), social sustainability (SS), and environmental sustainability (EnvS) through the mediating effect of supplier development (SD) and the moderating effect of agency problems (AP). [18]

Using data collected from 267 Bangladeshi apparel manufacturing companies supplying apparel to brands (buying customers), Yadlapalli et al. (2018) tested their hypotheses using PLS-SEM. The data supported the core premise of their theory: the responsible governance system, represented by SupS and ES, positively influences suppliers' triple bottom line (TBL) performance. This is one of the few studies that examine all three TBL outcomes of suppliers.

However, it is noteworthy that Yadlapalli et al. (2018) did not explicitly operationalize SD to indicate social or environmental aspects of sustainability. Instead, suppliers' TBL performance appears to be primarily driven by SupS, which encompasses initiatives considering economic, social, and environmental criteria in supplier selection. The study suggests that, in the context examined by Yadlapalli et al. (2018), SD alone is insufficient to represent a buyer's governance system that enhances suppliers' TBL sustainability—SupS is also a crucial component of this governance system. This is understandable, given that apparel supply chains are truly global, with numerous suppliers (contract manufacturers) both within and outside Bangladesh being able to supply apparel to global brands.

The conclusion is that with the exception of a handful of studies (e.g., Yadlapalli et al., 2018) there is no robust evidence (i.e., evidence derived from large-sample quantitative studies) demonstrating that SSD has occurred as it is currently understood in academia. Furthermore, the relationship between SD initiatives (or SSD initiatives, depending on how SD is defined) and suppliers' TBL has been rigorously examined seldomly in the existing literature, whether in the traditional manufacturing sector or the agri-food sector. *This remains a knowledge gap.*

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[18] SupS was modelled by Yadlapalli et al. (2018) as a second-order reflective-formative construct formed by the three reflective constructs economic supplier selection criteria, socially sustainable supplier selection criteria, and environmentally sustainable supplier selection criteria. SD was also modelled as a second-order reflective-formative construct formed by the two reflective constructs supplier assessment and supplier collaboration.

### 2.5.3 Sustainable SD in an AVC of a developing country (SD ∩ Sustainability ∩ AVC)

First, it is important to understand who the buyers are and who are the suppliers in an AVC The answer to this question lies in the reference point in the AVC. An input supplier (e.g. a fertilizer supplier or an equipment supplier) is a supplier to a farmer, who in turn becomes a supplier to a processor (a food company), who processes the commodities into value-added products. A processor is also a supplier for the downstream actors in the VC such as the distributors and retailers (Barnard et al., 2020; KMPG International, 2013). To avoid this confusion, the researcher uses the farmer-processor dyadic structure relation (here, the farmer becomes the supplier, and the processor becomes the buyer who will, hopefully, develop their farmers). Arguably, this dyadic relationship would work best under low third-party involvement, a fact that remains to be seen and established in the study context.

#### *2.5.3.1 Farmer development in developing countries and the question of farmer sustainability*

The researcher conducted a literature review using various keyword permutations and combinations to explore key questions: who develops farmers? what farmer development initiatives are being implemented? which farmer performance outcomes are targeted for improvement? and whether any of the three farmer TBL outcomes have been specifically addressed in farmer development programs.

As previously discussed, in operations and SCM, SD refers to a buyer's deliberate efforts to enhance a supplier's performance and/or capabilities (Krause, 1997). Within an agrifood value chain (AVC), farmers can be considered suppliers. In developing countries, these suppliers can be supported by other actors such as the governments and NGOs, not solely the buying firm. The reader should note that the phrase "supplier development," as used in the title of this thesis—*"A Supplier Development Framework for Agrifood Value Chains in Developing Countries: A Test on the Dairy Value Chain of Sri Lanka"*—reflects the operations and supply chain management (SCM) conceptualization of SD, referring to farmers being developed by buyers.

For the above reason, more emphasis has been given to studies that covered farmer development through buyer-led farmer development programs.

***The researcher's synthesis of the empirical research that covered farmer development***

The keyword combinations used in searching articles—Discover and Scopus article databases were used—published during the past 17 years (from 1983 to 2024) that covered farmer development (similar words were connected through the connector OR), the developing agent, and the farmer development methods/initiatives/practices in the same article resulted in 41 articles. Although the keywords ("developing countries" OR "low-income countries") did not feature in the keyword combinations, perhaps unsurprisingly, all 41 articles returned by Discover and Scopus were focused on developing countries.

Of these 41 articles returned, 15 met the inclusion criteria—must-have details, should cover implementations—and were analyzed further (see Chapter 2 Appendix 1 for more information). The remaining 26 articles (63% of the total) were excluded as they provided only general recommendations for farmer training and extension services, without exploring broader or specific outcomes.

**Table 2.4 Farmer development providers and countries in 15 selected articles**

| | **Farmer development provider** | | | | |
|---|---|---|---|---|---|
| **Author (Year)** | **Buyer (private)** | **Government** | **NGO/NPOs** | **Mixed (other)** | **Country** |
| Aniagyei et al. (2024) | | ✓ | | | Ghana |
| Mukucha and Chari (2024) | ✓ | | | | Zimbabwe |
| Zuza et al. (2024) | | | | ✓ | Malawi |
| Wang et al. (2023) | | ✓ | | | China |
| Bhatti et al. (2021) | | ✓ | | | Malawi |
| Mukucha and Chari (2021) | ✓ | | | | Zimbabwe |
| Imam et al. (2021) | | ✓ | | | Pakistan |
| Yitayew et al. (2021) | | ✓ | | | Ethiopia |
| Boyaci and Yildiz (2016) | | ✓ | | | Turkey |
| Zossou et al. (2012) | | ✓ | ✓ | | Benin |
| Maffioli et al. (2011) | | ✓ | | | Argentina |
| Savran et al. (2011) | | | | ✓ | Turkey |
| Van Niekerk et al. (2011) | | ✓ | | | South Africa |
| Ladele and Kuponiyi (2006) | ✓ | | ✓ | | Nigeria |
| Shibanda (1991) | | | ✓ | | Kenya |

**Abbreviations:** NGO–non-government organizations; NPO–not-for-profit organizations

Table 2.4 presents the providers of farmer development in the 15 cases discussed across the 15 articles, along with the respective countries. Of these, only three featured private buyers (two from the same authors). In the remaining cases, the governments of the respective countries predominantly led farmer development. In the studies that featured the governments, farmer development/training/capacity building was affected by government and private extension officers. The type of farmer development initiatives varied from study to study, as evidenced in Chapter 2, Appendix 1. Farmer development often hinged on training programs tailored to specific needs. However, the long-term impact of these programs on farmers' TBL sustainability remained underexplored in many regions. The articles indirectly addressed TBL outcomes, but only a few explicitly targeted implementing sustainable practices. Most articles indirectly addressed the achievement of economic outcomes for the farmers, but social outcomes were also referred to in the articles.

Table 2.5 depicts the details of the three cases where the private buyer remained the party who provided farmer development through multiple farmer development initiatives, and in one case, three different categories. Training and financial support appeared as the most common forms of farmer development initiatives in three cases. Mukucha and Chari (2021) found that contract farmers—the ones who are being contracted by the merchants—outperformed regular tobacco farmers. They attributed this superior performance to extra extension services—over and above the extension services all farmers receive through government extension officers—provided by merchants, in addition to funding. The other empirical study by the same authors (Mukucha & Chari, 2024) reported similar results. The study reported by Ladele and Kuponiyi (2006) refers to a comparison between three categories of parties involved and farmer development initiatives.

**Table 2.5 Summary of the three articles on farmer development initiatives implement by buyers**

| Author (Year) | Parties involved in farmer development | Farmer Development initiative | Developer-farmer interaction | Farmer performance outcomes targeted | Farmer TBL outcomes mentioned? |
|---|---|---|---|---|---|
| Mukucha and Chari (2024) | Buying firm (private)<br><br>Supplier development through contract farming agreements | - Training (over and above government extension services available in the region)<br>- Input materials (e.g. fertilizer, seeds)<br>- Production technology<br>- Credit support<br>- Guaranteed market<br>- Guaranteed price for the products | Vertical coordination between buyer and farmer | - Yield<br>- Delivery (uninterrupted supply to buyer)<br>- Targets via performance benchmarking<br>- Product quality | Economic (Implied) |
| Mukucha and Chari (2021) | Buying firm (private)<br><br>Supplier development through contract farming agreements | - Training (over and above government extension services available in the region)<br>- Funding<br>- Mechanization<br>- Input materials (e.g. fertilizer, seeds) | Vertical coordination between buyer and farmer | - Buyer cost performance<br>- Supplier (farmer) quality performance<br>- Supplier (farmer) delivery performance | Economic (Implied) |
| Ladele and Kuponiyi (2006) | *Category 1*<br><br>Buyer (private organization) → In-house extension officers | Buyer's *in-house extension system* provides<br>- Training and advice<br>- Sources all inputs and provides on a credit basis<br>- Interest-free loans for all the registered farmers,<br>- Evaluation and feedback on production practices | Direct and intensive interaction between buyer (extension officer) and individual farmer | - Profitability | Economic<br>Social<br>(Implied) |
| | *Category 2*<br><br>NGO (Private non-profit) → Hired extension officers | - Provide some inputs on credit<br>- Provide some inputs at a lower price<br>- Input delivery support<br>- Cash on credit | Somewhat distant interaction (e.g., Fortnight group meetings and communication through contact-farmers) | - Rural smallholder development | Economic<br>Social<br>(Implied) |
| | *Category 3*<br><br>Private non-profit organization→ Hired extension officers | - Only sourcing inputs<br>- In material transport support<br>- Cash on credit | Distant interaction (e.g. Annual farmers' day) | Capacity building and sustainable development | Economic<br>Social<br>(Implied) |

**Notes:** The different colors denote the similarity between the development initiatives in the three cases; the → means "through"

## 2.6 Knowledge Gaps

### 2.6.1 Knowledge gap 1: Processor-led farmer development initiatives are not well-known

A review of the literature revealed numerous studies (Section 2.2) that empirically examined the impact of SD on both supplier and buyer performance. The operational definitions of SD (i.e. the indicators of SD) varied from study to study, although common features were present. Empirical studies on AVCs that involved buyer-supplier scenarios to examine the impact of SD on supplier (farmer) performance were minimal (section 2.5.3). Only two studies were available (i.e., Mukucha & Chari, 2021, 2024), and in both cases, the processor was not involved, although there should be no reason why the processor cannot be the buyer under a certain AVC governance form (the process "VC analysis" was reviewed in 2.4.3). Given that supplier development initiatives and practices vary from context to context, even within the field of auriculate, and the processor has not featured in any of the prior empirical studies, it is concluded there is a knowledge gap on processor-lead farmer development initiatives. Of course, why the researcher needs to know the processor-lead farmer development initiatives in her study context is to test her theory, which leads to the next knowledge gap.

### 2.6.2 Knowledge gap 2: Want of a comprehensive theory on SSD based on processor-led farmer development

A review of the literature on SSD (Section 2.5.2) that empirically examined the relationship between SD initiatives and the supplier's sustainable performance (economic, social, and environmental performance) were found to be fragmented, and no study examined all three outcomes on farmer sustainability within a single study. No empirical study on buyer-initiated farmer development—this is to represent the concept of SD, as it is being understood in operations and SCM—that examined a farmer's sustainable performance amplifies the gap. Formulating and testing a theory to explain how processor-led farmer development leads to farmer's capability and performance improvement, and ultimately to economic, social, and environmental performance outcomes therefore remains a clear knowledge gap.

A review of the literature on SSD (Section 2.5.2) revealed that studies that empirically examined the relationship between SD initiatives and suppliers' sustainable performance (economic, social, and environmental) are fragmented. No single study has examined all three outcomes of farmer sustainability comprehensively. Moreover, the absence of empirical research on buyer-initiated farmer development—understood in operations and SCM as a form of SD—that evaluates farmers' sustainable performance further highlights this gap.

Consequently, developing and testing a theory to explain how processor-led farmer development improves farmers' capabilities and performance, ultimately achieving economic, social, and environmental outcomes, remains a significant knowledge gap.

### 2.6.3 Knowledge gap 3: Material flow and service exchanges between key actors in the VC are not well-documented

To develop a theory—especially if the theory is to be empirically tested using positivist methods—to explain a poorly understood phenomenon, it is essential to scope the theory, including the operational definitions of its constructs (the building blocks), within the context in which the theory and its test results will apply (Godfrey et al., 2010). The literature review revealed that the dairy VC in Sri Lanka has not been adequately studied in terms of its structure, governance form, and value flows (Section 2.4.4.1). Therefore, at a minimum, the material flow and service exchanges between key actors in the VC must be understood to complete the theory development and testing.

## 2.7 The initial conceptual model to design the research methodology

The conceptual model in Figure 2.6 outlines the key concepts and their interconnections, derived from the literature review. From an SD perspective, certain initiatives must be implemented by the buyer (the cause, in a hypothetico-deductive sense) to achieve desired outcomes. Accordingly, "farmer development initiatives" undertaken by the buyer—considered to be the milk processor, subject to ratification via fieldwork—are conceptualized as the cause. Given the limited knowledge about Sri Lanka's dairy VC, the model includes several key questions to guide the researcher during fieldwork.

According to the literature, the immediate outcomes of SD initiatives from the supplier's perspective are supplier performance and the buyer-supplier relationship. The model also includes key questions to address during fieldwork and further literature review, including whether "farmer performance" is the appropriate label. The researcher's theory seeks to explain the causation of sustainable farmer performance as a result of farmer development initiatives, thus farmer performance as a label confuses the reader (farmer performance was relabelled as farmer capability in the next chapter).

Sustainable farmer performance—encompassing economic, social, and environmental dimensions—has been conceptualized as the ultimate outcome of farmer development initiatives. Key questions related to sustainable farmer performance have also been identified as action points for further investigation.

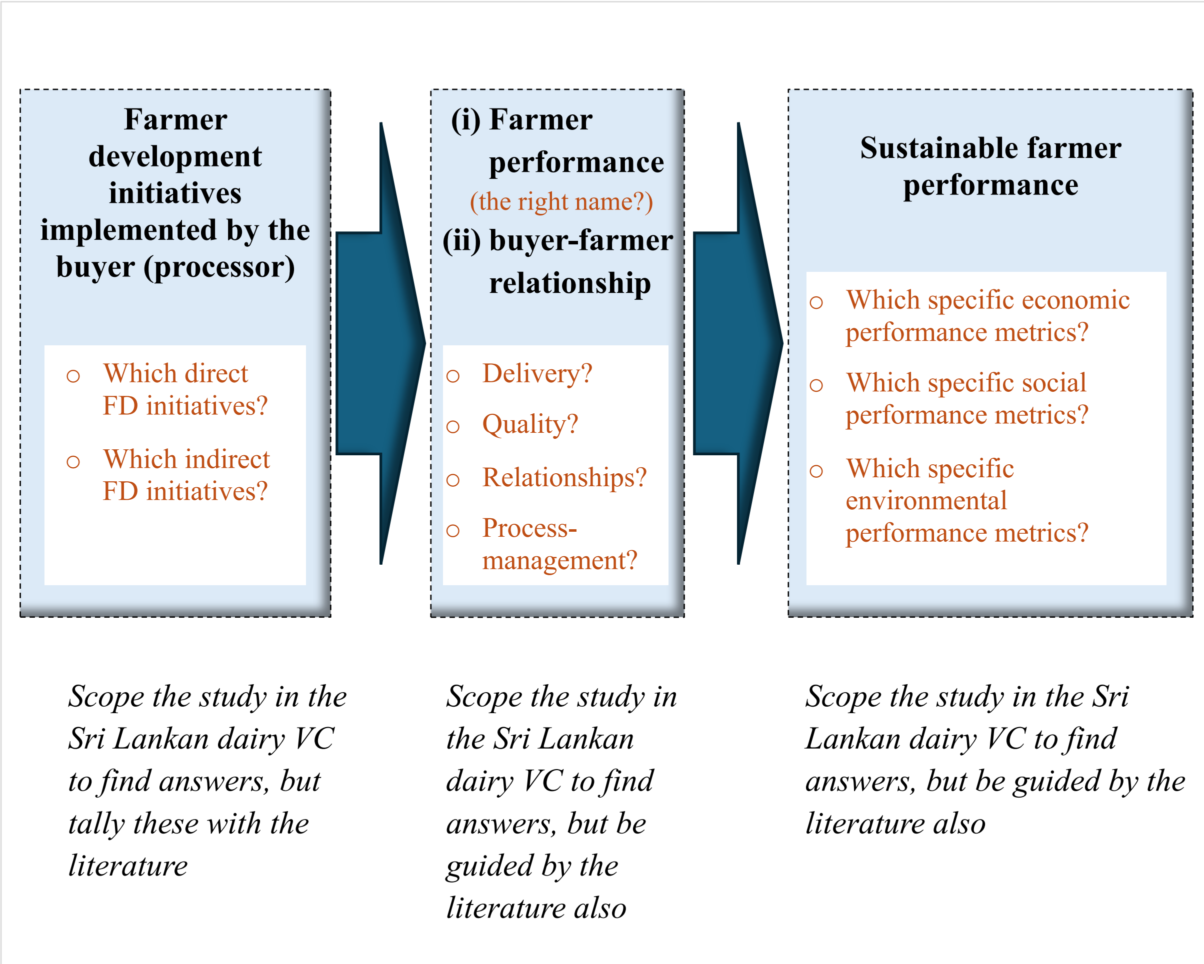



**Figure 2.6 The initial conceptual model**
*(Source: Own work)*

### 2.7.1 The theoretical lenses that will be used in theory development in the subsequent chapters

Theory development in new management disciplines (e.g., SCM, information science) often requires combining multiple theoretical lenses to provide a more complete critique of the social world (Niederman & March, 2019; Okhuysen & Bonardi, 2011). A theoretical lens (theory + lens) is the established management theory—there are several established management theories an SC scholar could choose from—that a scholar uses as their lens to view a social phenomenon to synthesise new theory (Niederman & March, 2019; Okhuysen & Bonardi, 2011).

The researcher employs three different theoretical lenses—each corresponding to an established management theory—to analyze three distinct social phenomena: (1) improving farmer capability through farmer development initiatives, (2) fostering long-term relationships between the processor (buyer) and the farmer (supplier) as a result of farmer development, and (3) the processor making a deliberate effort to achieve TBL outcomes for their farmers.

For phenomenon (1), the researcher applies the resource-based view (RBV) of competitive advantage to develop hypotheses. The RBV is a foundational theory in strategic management which argues that so long as a firm's resources (e.g., knowledge, people, technology, physical infrastructure) are valuable, rare, inimitable, and non-substitutable, the firm can gain a competitive advantage (Barney, 1991).

For phenomenon (2), the researcher applies the relational view to develop hypotheses. The relational view posits that organizations form and sustain strategic relationships to create unique value that cannot be achieved independently (Dyer & Singh, 1998; Homans, 1958). It emphasizes that collaborative relationships enable the sharing of resources and capabilities, leading to "relational rent," a form of superior performance derived from cooperative inter-organizational dynamics. Within this framework, relationships are built and maintained through investments that foster trust, commitment, and alignment of mutual goals. The theory underscores that such investments create long-term benefits for both parties, incentivizing cooperation and reinforcing loyalty over time.

For phenomenon (3), the researcher utilizes stakeholder theory (ST) (Donaldson & Preston, 1995; Freeman, 1984; Freeman et al., 2018; Harrison et al., 2019; Hörisch et al., 2014; Jones, 1995) to complete the theoretical framework, extending farmer capability and processor-farmer relationship improvements (resulting from farmer development) to include improvements in the farmer's TBL outcomes. Consequently, ST serves as the overarching theory that integrates the researcher's theoretical model. Donaldson and Preston (1995) analyzed the descriptive, instrumental, and normative sub-theories of the ST. The *descriptive ST* highlights that shareholders are just one of many important stakeholders of an organization; stated simply, the descriptive ST holds that an organization has stakeholders (Donaldson & Preston, 1995; Jawahar & Mclaughlin, 2007). *The instrumental ST* argues that an organization should manage its stakeholders because without managing the stakeholders effectively, the organization will not be able to achieve its long-term goals: profitability and growth (Donaldson & Preston, 1995; Harrison et al., 2019; Hörisch et al., 2014; Jones, 1995). The *normative ST* argues that stakeholders of an organization have intrinsic value on an organization and that they have legitimate stakes on the organization (Brown & Forster, 2013; Donaldson & Preston, 1995).

## 2.8 Chapter summary

The review of the literature on SD (Section 2.2) revealed that not much is known about the types of SD initiatives (practices) implemented by buyers and their effectiveness for both buyers and suppliers. The dichotomy of indirect versus direct SD initiatives, introduced by leading researchers years ago, remains relevant today, as reflected in the extant literature. The synthesis highlighted that supplier performance has traditionally been measured through product quality and delivery, which buyers aim to improve via SD programs. However, some studies have also considered other dimensions of supplier performance, such as flexibility. Notably, not all studies employing hypothetico-deductive methods found statistically significant results, with some showing no significant improvements in supplier performance through SD.

The review of the literature on sustainability (Section 2.3) revealed that sustainable development and sustainability reporting could play an important role in processor-initiated farmer development. The review of literature on AVCs (Section 2.4) revealed that analyzing value chain structures, governance forms, and value addition is crucial. However, these aspects have not been adequately explored in the context of Sri Lanka's fresh milk value chain.

The review of literature on SSD (Section 2.5.2) revealed that SSD as a theoretical concept has not been rigorously tested by empirical researchers, either in traditional manufacturing sectors or the agrifood sector. Similarly, the review of literature on farmer development in developing countries showed that buyer-initiated farmer development—akin to SD in operations and supply chain management—has not been extensively studied, with only three relevant studies identified.

The need for a validated theoretical model explaining how buyer-led farmer development leads to sustainable outcomes for farmers was highlighted. In this regard, a conceptual framework to initiate theory development was proposed. The next chapter details the development of a broad-spectrum (genetic) theoretical model—derived entirely from the literature—to explain how processor-led farmer development could result in TBL outcomes for farmers.

## Chapter 2, Appendix 1: A Summary of the articles on farmer development initiatives not involving the buyers

| Author (Year) | Parties involved in farmer development | Development initiative | Developer-farmer interaction | Farmer performance outcomes targeted | Farmer TBL outcomes mentioned |
|---|---|---|---|---|---|
| Aniagyei et al. (2024) | Government through Agricultural extension service | - Demonstration farms<br>- Farmer training (e.g. best practices)<br>- Group meeting (extension officer and fellow farmers)<br>- Farm visit (visit other leader/demonstration farms)<br>- Home visit (extension offers visit farmer)<br>- Mass media (e.g., Radio) | - Extension officers and farmer<br>- Farmer networking and mutual support | Product Quality | Sustainability (Implied) |
| Zuza et al. (2024) | Government | - Affordable inputs<br>- Irrigation and dairy farming<br>- Good agricultural practices and sustainability initiatives (e.g., climate change adaptation, agroforestry)<br>- Agribusiness<br>- Promotion of livestock products (e.g., dairy farms)<br>- Market linkages | - Lack of coordination<br>- collaboration among the stakeholders including farmers | Indirectly Mentioned about productivity and performance | Economic, social, and environmental |
| | NGOs | - Material support (e.g. seeds, irrigation)<br>- Credit support (e.g., loans & microfinance)<br>- Health and improved livelihoods<br>- Early childhood development<br>- Farmer field schools<br>- Good agricultural practices and sustainability initiatives (e.g., climate change adaptation, agroforestry) | | | |
| | Farmer-based organization | - Credit support<br>- Good agricultural practices and sustainability initiatives (e.g., climate change adaptation, agroforestry)<br>- Promotion of agroforestry<br>- Material support (e.g. seeds) | | | |
| | Multilateral organizations (e.g., FAO) | - Farm field school<br>- Good agricultural practices and sustainability initiatives (e.g., climate change adaptation, agroforestry) | | | |
| Wang et al. (2023) | Research institute→New agricultural business entities (NABESs)→smallholder farmers | - Access to technological information on the adoption of sustainable intensification practices<br><br>**Mechanism:**<br>Government research institutions maintain a direct connection with NABES (e.g., family farms, cooperatives, leading agricultural enterprises) who then in turn disseminate the information to smallholder farmers as opinion leaders. | - Direct interaction between Developer (research institution)-mediator (NABEs) and smallholder farmer | Technology adaptation | Only environmental sustainability |

| Author (Year) | Parties involved in farmer development | Development initiative | Developer-farmer interaction | Farmer performance outcomes targeted | Farmer TBL outcomes mentioned |
|---|---|---|---|---|---|
| Bhatti et al. (2021) | Government →Extension service officers→ Leader farmers→smallholder farmers | - *'Lead and follow'* farmer training on best practices<br><br>**Mechanism:**<br>Government extension service providers train the leader farmers and leader farmers train smallholder farmers | - Not mentioned | Farmer productivity | Economic, social, and environmental sustainability |
| Imam et al. (2021) | Government→Farmer field schools→ smallholder farmers | - Farmer training (e.g., basic cultivation, irrigation, pest and disease control, harvesting, and post-harvesting, farm management) | - Not mentioned | New technology adaptation and capability improvement (e.g., application of learning through training) | Not mentioned |
| Yitayew et al. (2021) | Government → development agents→farmers | - Farmer training<br>- Demonstration trials for farmers<br>- Field days | - Close interaction between the development agent and the farmer<br>- Farmer-to-farmer interaction | Technology adaptation | Economic |
| Boyaci and Yildiz (2016) | Government →Public extension service→farmers | - Farmer training<br>- Field visit<br>- Demonstrations<br>- Mass media | - Lack of collaboration between all the stakeholders | Technology transfer and capability building | sustainable development (Implied) |
| Zossou et al. (2012) | Government partnership with NGOs | - Training<br>(e.g., expert training, farmer-to-farmer participatory learning through videos*)<br><br>*Farmer-to-farmer learning was found effective compared to conventional expert learning<br><br>**Mechanism:**<br>In collaboration with some experienced farmers, the government institute developed a video to educate their fellow farmers. The video was then shown to farmers during a training session conducted through an NGO. | - Interaction between farmer-to-farmer<br>- Interaction between farmer and other VC actors (e.g., sellers) | - Apply the training knowledge<br>- Improvement in the quality of the production process and final product using a new technology<br>- Improvement in farmer relational skills | Improvement in farmer social, economic, and environmental performance |

| Author (Year) | Parties involved in farmer development | Development initiative | Developer-farmer interaction | Farmer performance outcomes targeted | Farmer TBL outcomes mentioned |
|---|---|---|---|---|---|
| Maffioli et al. (2011) | Government→contracted private agricultural specialists | - Technical advice on the production process<br>- Training on how to use variable inputs (such as water, and fertilizer).<br><br>*Farmers were given a choice of 8 topics to select relating to the above areas<br><br>**Mechanism:**<br>The government introduced a short-term (3 years) program and provides free extension services to farmers through contracted private agricultural specialists | - Not Mentioned | - Yield<br>- Quality | Economic (Implied) |
| Savran et al. (2011) | Government→extension officers | - Training programs<br>- Information support (e.g., printed materials, videos, TV)<br>- Advisory support<br>- Field days<br>- Farmer meetings<br>- Demonstrations<br>- Farmer visits<br>- Competitions, conferences, etc | Lack of effective communication between all the stakeholders | Agricultural extension system | Economic, social, and environmental sustainability (Implied) |
| | Other (private extension service providers) Processing firms, farmer associations, cooperatives, agricultural consultants, mass media, NOGs, Universities) | - Financial support<br>- Input materials<br>- Marketing of agricultural products<br>- Contract farming<br>- Technical support | | | |
| Van Niekerk et al. (2011) | Government→extension officers | - Farmer training (e.g., farm process management),<br>- On-farm demonstrations<br>- Linking farmers with the other actors along the VC | Improve communication between farmer and extension officer | Farmer capability development (e.g., relational skills), innovation, farmer mobilization (e.g. adopting new ideas) | Sustainability and sustainable farmer development |
| Shibanda (1991) | Government→agricultural research centres → extension officer | - Provide information (e.g., new technology suitable for the country via publications)<br>- On-farm demonstrations<br>- Farmer training centres<br>- Mass media<br>- Farm visits | Lack of communication between all the stakeholders | Not mentioned | Not mentioned |

# CHAPTER 3:
# SUSTAINABLE FARMER DEVELOPMENT FOR AGRI-FOOD SUPPLY CHAINS IN DEVELOPING COUNTRIES

This chapter has been published in the journal 'Sustainability' on 20$^{th}$ October 2023. Sustainability is a peer-reviewed and open-access journal (Publisher: MDPI, Basel, Switzerland) that provides a high-quality research forum on sustainability and sustainable development. It is classified as a Q1 journal (in Geography, Planning, and Development) with an impact factor of 3.9 in 2023 (with a 5-year impact factor of 3.6 in 2023), and is indexed by Scopus, SCIE, and SSCI (Web of Science), AGRIS, etc. This paper has received 6 citations in Google Scholar since it was published.

This chapter presents the initial development of the theoretical model to partially achieve RO2. It also served as a theoretical platform for conducting the initial fieldwork (the semi-structured interviews) in studying the dairy VC of Sri Lanka, from the lens of a post-positivist. The researcher used supplier development (SD) literature in operations and supply chain management to project farmer development (FD) as being conceptually analogous to SD, notwithstanding the differences between AVCs in developing countries and non-food VCs. The theoretical model advances the overarching proposition that FD initiatives lead to the development of farmer capabilities (FC) and improvements in the processor-farmer relationship (PFR), which in turn, enable farmers to achieve sustainable performance across economic, social, and environmental dimensions. Based on the literature, the researcher provides working definitions for the identified concepts (i.e. FD, FC, PFR, Farmer Economic Performance, Farmer Social Performance, and Farmer Environmental Performance. Consequently, his initial theoretical model served as the launching pad for the work covered in Chapter 4 and Chapter 5.

**Abstract**

Improving the supplier's capabilities and relationships with the buyer to improve triple-bottom-line outcomes for multiple actors in the supply chain (including the suppliers and buyers) is the very purpose of sustainable supplier development. We apply the concept of sustainable supplier development in an agri-food context in a developing economy. The study aims to create a theoretical framework that explains how initiatives by buyers (often processors in the agri-food industry) to develop farmers can result in sustainable farmer performance. Collectively, the propositions derived by us via literature synthesis propose that farmer development leads to farmer's capability development and improved relationships (with the buyer) enabling the farmer to achieve sustainable performance (i.e. performance in economic, social, and environmental domains). The importance of the study from a theory-building perspective is that the study attempts to reconcile supply chain management literature on supplier development in tangible goods manufacturing with the agribusiness literature in developing economies whether or not the farmer occupies the bottom of the income pyramid. The study is also important to academia and policymakers because it acts as a forerunner for further development of the theoretical model and testing with large sample data to interpret what the results imply from practical and theoretical standpoints.

**Keywords:** developing economies; farmer development; supply chain; sustainability

## 3.1 Introduction

The competitive position of a focal firm is heavily dependent on its ability to manage the Supply Chain (SC) efficiently and effectively. A manufacturing firm in a SC depends on its suppliers to provide high-quality goods and services in a timely manner, at competitive prices, and to improve the SC performance (Paybarjay et al., 2023, p. 12). In physical goods manufacturing, a manufacturing firm would focus mainly on its key competencies to gain a competitive advantage and outsource the rest due to strategic reasons. As a result, typically a large number of suppliers are involved because many different components and services that are required for the production and assembly of finished goods need to be purchased from outside suppliers. Comparatively, in Agri-Food Supply Chains (AFSCs), a large number of farmers are involved as suppliers of commodities because each farmer has only a limited capacity to produce the commodity. Either way, managing the supplier base is of utmost importance to a focal firm in a SC (Jia et al., 2021).

In this milieu, if a supplier is performing sub-optimally, the purchasing company may switch the supplier (move to another), recourse to backward integration (acquire the supplier's business), or develop the supplier (Krause et al., 1998) to improve their performance. However, due to the inherent drawbacks of the first two alternatives, many firms attempt to develop their suppliers to perform optimally (Krause & Ellram, 1997). If correctly implemented, developing the suppliers to improve their capabilities results in generating benefits to both the supplier and buyer by strengthening the SC while preventing the deterioration of the supply links (Lee et al., 2018).

In Supply Chain Management (SCM) literature, the concept of Supplier Development (SD) refers to developing the capability and capacity of core suppliers through highly collaborative relationships for gaining mutually beneficial business outcomes (Benton et al., 2020; Chavhan et al., 2018; Krause et al., 2007; Paybarjay et al., 2023). The term SD was initially coined by Leenders in 1966 and thereafter gained interest in both academia and practice. Today, it has become an established concept that looks beyond short-term gains for the buyer and the supplier. Sustainable SD is a concept that receives significant attention in contemporary SD literature (Bai & Satir, 2022; Busse et al., 2016; Sancha et al., 2015; Zimmer et al., 2016). Sustainable SD refers to the actions taken by the buyer to improve the capability of its suppliers that eventually improve the Triple-Bottom-Line (TBL) performance—economic, social, and environmental —of multiple actors along the SC, including the supplier and the buyer (Bai & Satir, 2022).

Most of the studies covering SD concepts such as SD strategies, supplier performance measurement, and buyer-supplier relationship development have been conducted in relation to developed countries (Pedroso et al., 2021; Silva & Jayarathne, 2018) pioneered by the automobile industry (Glavee-Geo, 2019). However, more recently, there has been a rapid increase in studies that incorporate SD in developing countries with a sustainability focus (Jia et al., 2021). High populations and a large proportion of people living below the poverty line (bottom of the income pyramid) in developing countries mean there is substantial scope for some firms such as multinational and large-scale local firms to do business with these bottom-of-the-income pyramid communities to improve TBL outcomes for the bottom of the income pyramid communities (poor communities) as well as firms that do business with these communities—a concept known as the bottom (or base) of the pyramid (BOP) approach of doing business with the poor (Dembek et al., 2020; Verwaal et al., 2022). In relation to agriculture in developing economies, this approach can be extended to developing farmers who supply commodities to firms that process these commodities to produce consumer goods, including food products (Brix-Asala et al., 2021). This creates opportunities for a focal firm to develop a large number of farmers supplying a commodity (e.g., dairy farmers, cocoa farmers, fruit farmers) because as mentioned earlier, each farmer has only a limited capacity to supply the commodity.

Compared to the developed countries, agriculture continues to be the main source of employment, livelihood, and source of income for the masses in developing countries. Of this, smallholder farmers make up the majority and a key player in agriculture SCs in developing countries (Hidayati, Garnevska, & Childerhouse, 2023; Hidayati, Garnevska, & Ramilan, 2023). However, apart from limited capacity they also face many challenges along the AFSC including limited access to resources, lack of infrastructure, inability to comply with quality requirements, heavy dependency on middlemen, and, limited financial resources (Akamp & Müller, 2013; Joshi et al., 2023; Yadav et al., 2022). Therefore, they are considered the weakest (Hidayati et al., 2021) in the AFSC, thus room for their development. Addressing these challenges through farmer development efforts requires a comprehensive approach that includes improved access to resources, better market linkages, capacity building, climate-resilient farming practices, and supportive policies that recognize the unique needs of smallholder farmers in the AFSC.

In physical goods manufacturing, the manufacturing firm that buys parts (e.g. automobiles) from the suppliers is focused on limiting the number of suppliers of the same part/component to fewer suppliers for cost reduction and quality assurance reasons (Taherdoost & Brard, 2019). Physical goods manufacturing firms can afford to optimize the supplier base (e.g., reduce the number of suppliers supplying the same part and divert resources to develop these selected few suppliers supplying critical components) this way and have closer relationships with their core suppliers for mutual gains because the suppliers have the capacity to meet the demand required by the manufacturing firm. As such, in physical goods manufacturing, suppliers who supply critical components receive more direct forms of SD such as training, and implicit knowledge transfer, while suppliers who supply other components or services receive indirect forms of SD such as supplier evaluation and feedback to improve capability and performance. However, this type of optimization through supplier relationship management as selecting, segmenting, and developing the supplier is not possible in agri-food contexts in developing economies due to the aforementioned issues on capacity and challenges along the AFSC. Yet developing the farmers in developing economies through a suitable business model (e.g., the BOP approach) is important for both the firm initiating farmer development (for company growth) and the farmers (for their TBL sustainability). Further, the choice of such a farmer development model should also consider the specific context, available resources, and goals of the region or country in question. Consequently, the approach to farmer development may vary from country to country, but there is a need to develop a parsimonious theoretical model that can be generalized across many settings, which provides the motivation for this study. Given the fact that there is still little understanding of the causal mechanism between farmer devolvement initiated by the buying firm (the driver) and the TBL outcomes of the farmer (response) (Yawar & Seuring, 2018).

Accordingly, the main aim of this study is to develop a theoretical model that connects farmer development, farmer capability, farmer-processor relationship, and farmer's TBL performance in developing economies. This research is leading to the development of a conceptual/theoretical framework that explains how farmer development results in improved TBL outcomes of a farmer is based on a narrative review (Hidayati et al., 2021). The review employed keyword search in SCM and Agribusinesses journals in Google Scholar and Scopus article databases for suitable literature. The narrative-based literature review discussion starts with the fundamentals of AFSC in developing countries followed by a more in-depth discussion on the use of farmer development, sustainable farmer performance, farmer capability, and farmer-processor relationship in AFSC in developing countries. We use SD theory (including the concepts related to sustainable SD) as a suitable platform to develop our propositions for agribusiness in a developing country context. The propositions developed by us collectively explain the causation of the TBL performance of a farmer through the farmer's capability development and improved relationships due to activities initiated by the buying firm. In our theory, farmer capability and farmer-processor relationship play a mediating role in the relationship between farmer development and farmer's TBL performance.

The importance of the study is twofold. Firstly, the study aims to understand to what extent core concepts on SD found in SCM literature such as strategic supplier selection, direct SD, and indirect SD (Benton et al., 2020; Krause & Ellram, 1997; Saghiri & Wilding, 2021; Wagner, 2009) fit in an agribusiness context in a developing economy, at a theoretical level. By exploring how these established SCM concepts can be adapted and integrated into the unique dynamics of agribusiness, the study aims to provide valuable insights. This is especially important because agribusiness involves distinct challenges, stakeholders, and SC characteristics compared to other industries in a developing economy. The findings in this regard are expected to contribute to academia by bridging the gap between SCM and agribusiness disciplines. Such interdisciplinary insights are considered highly valuable and needed (Agnusdei & Coluccia, 2022) for a more comprehensive understanding of farmer development in the agri-food sector. Secondly, since we propose an empirically testable theory on farmer capability development and farmer performance improvement—as opposed to a list of things to do to achieve the said outcomes—our study will provide valuable guidance to researchers, practitioners, and policymakers in the agribusiness domain. By rigorously assessing the proposed model with large sample data, the study can shed light on which specific initiatives are most effective in fostering farmer capability development and improving farmer performance. This is particularly valuable in the context of developing economies where sustainable practices and smallholder farmer empowerment are critical for economic development and poverty reduction.

The remainder of this paper is structured as follows. Section 2 discusses the possible theoretical lenses to study SD. Section 3 reviews the literature relating to the area of study and leads the path to Section 4 on the development of propositions and theoretical models. Finally, Section 5 concludes the study by outlining key implications, study limitations, and suggestions for further research.

## 3.2 Possible theoretical lenses to study farmer development

Several theoretical lenses can be applied to studies related to SD from the point of view of a buying firm. However, in agribusiness literature, the relational view and resource-based view have been used as theoretical lenses to operationalize buyer-supplier relationships as relationship quality (Lages et al., 2009; Lees et al., 2020; Schulze & Lees, 2014).

The *resource-based view* is a prominent theoretical framework in strategic management and organizational theory that focuses on how a firm's unique and valuable resources contribute to its competitive advantage and overall performance. The theory was developed in the 1980s and 1990s by Jay Barney, Birger Wernerfelt, and Gary Hamel. The resource-based view emphasizes a firm creating inimitable (difficult to replicate) resources and capabilities for gaining competitive advantage. Resources of a firm that are valuable, rare, inimitable, and non-substitutable enable the firm to enter a market and earn a profit whilst the firm's distinctive capabilities make better use of its resources.

The *relational view* is a perspective often used in management and organizational theory to understand how firms create value through relationships, partnerships, and interactions with various stakeholders (Dyer & Singh, 1998). It emphasizes the importance of relationships and network connections in shaping a firm’s strategic decision, competitive advantage, and overall performance. Relational view also can be identified as is an important derivation of the resource-based view (Tescari & Brito, 2018). Therefore, these two complementary theories have been used in this study of proposition development. The relational view is the raison d'etre of the concept “farmer-processor relationship” (the processor being the buyer) while the resource-based view can be used to justify unique ways of farmer development as a strategy of the buying firm to develop its competitive standing.

## 3.3 Literature review

In this section, we explore the existing literature on several key topics related to sustainable farmer development in AFSC in developing countries. The literature review enabled us to adapt SCM literature such as supplier development, buyer-supplier relationship, supplier capability, and sustainable supplier performance to an agribusiness context in developing countries. As mentioned earlier the study employed a narrative review to build up the storyline. The narrative review provides a broad overview of the literature which is well suited for theoretical framework development and useful when studying a topic with limited prior research to gain a preliminary understanding of a topic before conducting a more rigorous study (Green et al., 2006; Neuman, 2013) that involves full operationalization of the constructs, large sample data collection, and hypothesis testing (i.e. theory testing).

**Table 3.1 Journals and search words used in the narrative review**

| Key Journals Searched | Keywords Searched |
|---|---|
| International Food and Agribusiness Management Review<br>International Journal of Physical and Distribution & Logistics Management<br>Industrial Marketing Management<br>Journal of Cleaner Production<br>Journal of Purchasing and Supply Management<br>Journal of Agribusiness in Developing and Emerging Economies<br>Supply Chain Management: An International Journal<br>Sustainability | "Supplier development"<br>"Farmer development"<br>"Supplier capability"<br>"Farmer capability"<br>"Buyer-supplier relationship"<br>"Farmer-processor relationship"<br>"Relationship quality"<br>Agri-food*<br>Agri-food* AND ("developing countries" OR "emerging nations")<br>"Sustainable supplier performance"<br>"Sustainable farmer performance"<br>"Triple bottom line performance" AND Farm* |

### 3.3.1 Sustainable agri-food supply chains in developing countries

SCM as an academic discipline has evolved over the years from a highly goods-dominant logic (a logic based on making and shipping the goods with the expectation that revenue will flow somehow other from the economic transactions) to a more service-dominant logic that relies on resource-sharing, relationships, value networks, and so forth (Altuntas Vural, 2017). However, the SCM concepts and methodologies have been incorporated into agriculture development, but not much attention has been paid to industry-specific SCM concepts and theory building in the field of agriculture. The academic and commercial interest of SCM in agribusiness arose in the late part of the 20$^{th}$ century (during the 1990s) starting from Europe, the USA, and then to the developing countries by the 21$^{st}$ century (Woods, 2003). During that time, Michael Porter, a leading figure in the study of strategic management introduced the concept of *value chain* as a strategic management concept to explain how a firm creates value through a sequential process, commencing from inbound logistics. Thereafter, he put forward his seminal article "What is strategy?" (1996) and the concept of achieving sustainable competitive advantage through chain relationships. In the practice of SCM, the value chain concept manifests as a *value system* consisting of the following: the supplier, the channel, and the buyer value chain remarking that an SC has a wider perspective than a value chain.

However, the term value chain is often viewed in discussions on Agri-food. The reason for this may be the service-dominant perspective rather than the goods-dominant perspective in agri-food where what flows through AFSC are commodities rather than tangible goods. For this study, we use the following working definition of SCM: "Supply chain management is the management of relationships in a network of organizations, from end customers through original suppliers, using key cross-functional business processes to create value for customers and other stakeholders" (Lambert, 2014, p. 2)(p. 2).

Then, we project the above working definition to AFSC as "a set of activities in a 'farm-to-fork' sequence including farming (i.e. land cultivation and production of crops), processing/production, testing, packaging, warehousing, transportation, distribution, and marketing"(Tsolakis et al., 2014, p. 2)(p.48). Owing to its inherent characteristics—perishability, seasonality, short life cycle, variability in quality, variability in production and specialized transportation required (Joshi et al., 2023)—AFSCs vary from generic SCs in the flow of goods and information (Yadav et al., 2022). Consequently, AFSCs differ from traditional SCs in the areas of relationship and governance, coordination and integration, collaboration among stakeholders, SC agility, logistic management, traceability, packaging, and waste management (Sufiyan et al., 2019).

The AFSCs carry a large array of commodities that have different levels of perishability, including items such as dairy products, grain, vegetables, meat/fish, flowers, and fruit (Routroy & Behera, 2017). An AFSC can be divided into two main sub streams: *Agri supply chain for fresh agricultural products* and *Agri supply chain for processed food products* (Van der Vorst et al., 2007). The main processes of Agri SC for fresh agricultural products (such as vegetables, flowers, and fruits) are handling, conditioning storing, packing, transportation, and especially, trading of these goods. Agri SC for processed food products (such as meats, snacks, juices, desserts, and canned food products) involves the flow of agricultural products used as raw materials for producing consumer products with higher added value. In narrowing down the scope, this study will look at AFSC from the second perspective mentioned above, in the developing economy context. Hence, we will use the term processor to represent the buyer.

Same as AFSCs involving farmers in developed countries, AFSCs involving smallholder farmers in developing countries also face the cost-price squeeze, but there are greater opportunities for farmers in developing countries due to the expansion of the total population. In helping the farmers take advantage of this – domestic farmers' capacity should be developed to match the products that exporting countries will be aiming to put into the burgeoning Asian market (Woods, 2003). In a developing economy, often the agri-food market is characterized by a limited number of processors relying on a large number of suppliers, of whom the majority happen to be smallholder farmers (Blackmore et al., 2022; Shingh et al., 2020). Also, in such contexts, the informal market retains a larger portion compared to the formal market. This is particularly pervasive in perishable goods SCs such as dairy, in developing economies (Blackmore et al., 2022; Hemme et al., 2004; Shingh et al., 2020) but need attention for development. These traditional AFSCs are also characterized by multiple levels, poor technology, lack of support from government or related authorities, fragmentation, highly variable standards, poor infrastructure, and limited logistical support (Hidayati et al., 2021; Kilelu et al., 2017; Trienekens, 2011; Woods, 2003). Tactically, this has been addressed by global chains entering developing economies with low-priced products. Further, studies on traditional AFSC in developing countries have pointed out that farmers in AFSC remain weak due to the involvement of intermediary parties – middlemen along the chain. Such middlemen were usually identified as powerful parties who extracted the value at the expense of farmers. While alternative views are on their elimination or empowerment, this study holds the view that from farmers' vantage point, more closer the farmer is to buying firm (processor) more benefits will be generated for farmers in developing countries' context (Akram et al., 2023; Mazhar et al., 2022; Meemken & Bellemare, 2020); yet, the processors should be given more room to develop their farmers for better performance (Akram et al., 2023; Stringer et al., 2020).

In addition, with the heavy reliance on SC, firms are now held responsible for the strong economic, environmental, and social performance of their suppliers and partners (Mani et al., 2016; Seuring et al., 2008). In sustainable SCM literature, the inclusion of sustainability most often is based on TBL, claiming equal consideration for all three dimensions of sustainability (Beske & Seuring, 2014). The first definition of sustainable SCM was found in 1996 and for this study, we focus the sustainable SCM definition as “The strategic, transparent integration and achievement of an organization’s social, environmental, and economic goals in the systematic coordination of key inter-organizational business processes for improving the long-term economic performance of the individual company and its supply chains” (Carter & Rogers, 2008, p. 368)(p. 368).

Similarly, the growing attention to sustainable development in the agri-food industry (Sharifi et al., 2023) made the sustainability concept critical for AFSCs (Joshi et al., 2023). One of the widely accepted definitions of sustainability is that was provided by the United Nations:

sustainability is "meeting the needs and aspirations of the present generation without compromising the ability of future generations to meet their need” (Brundtland, 1987, p. 292). A sustainable AFSC refers to a system that is designed, managed, and operated in a way that minimizes its negative impacts on the environment, society, and economy (Chari et al., 2023). This approach to SCM integrates environmental, social, and economic considerations to create a more responsible and resilient system for producing, processing, distributing, and consuming food. Drawing insights from the literature a sustainable AFSC can be identified as a "network that focuses on closely cooperating enterprises of a value chain with executive coordination provided to coordinate material flow and to foster close working relationships” (Mangla et al., 2018, p. 381)(p. 381). Such TBL-focused sustainable SC (i.e., sustainable SD) will eventually use SC partner selection, SC partner development, and long-term relationships for the better continuation of sustainability (Beske et al., 2014). However, there is a need to develop a theoretical model to examine the fitness of these concepts in an AFSC setting in developing economies. Accordingly, this study focuses on achieving SC sustainability from the supplier’s perspective (farmer’s perspective) proposing a conceptual framework. As argued earlier, there is a business case for developing farmers in developing countries (e.g. via the BOP approach) by farmer development activities initiated by buying firms who have the capacity to do so, within a sustainable supplier development paradigm (Brix-Asala et al., 2021; Dembek et al., 2020), thus justifying the conceptual framework. Figure 3.1 depicts the use of SCM theory in AFSC, further narrowing down to smallholder farmer TBL performance in developing economies. The AFSC in developing countries and developed countries can vary significantly due to differences in infrastructure, technology, agricultural practices, government support and sustainable practices (Akamp & Müller, 2013; Galal & Moneim, 2016). This means that specific farmer development initiatives initiated by the buyer in a developed country can be very different from those initiated by a buyer in a developing country. This means that the meaning of the concept of “farmer development” can be different between developed and developing countries. Our focus is on farmer development in a developing economy in contexts where there is a motivation for the buyer (the party who processes the agriculture produce supplied by the farmers) to develop the farmers. With this in mind, we cover the concepts supplier development, supplier capability, supplier relationship and supplier performance (TBL outcomes for the farmer to be more specific) with suitable modifications where relevant.

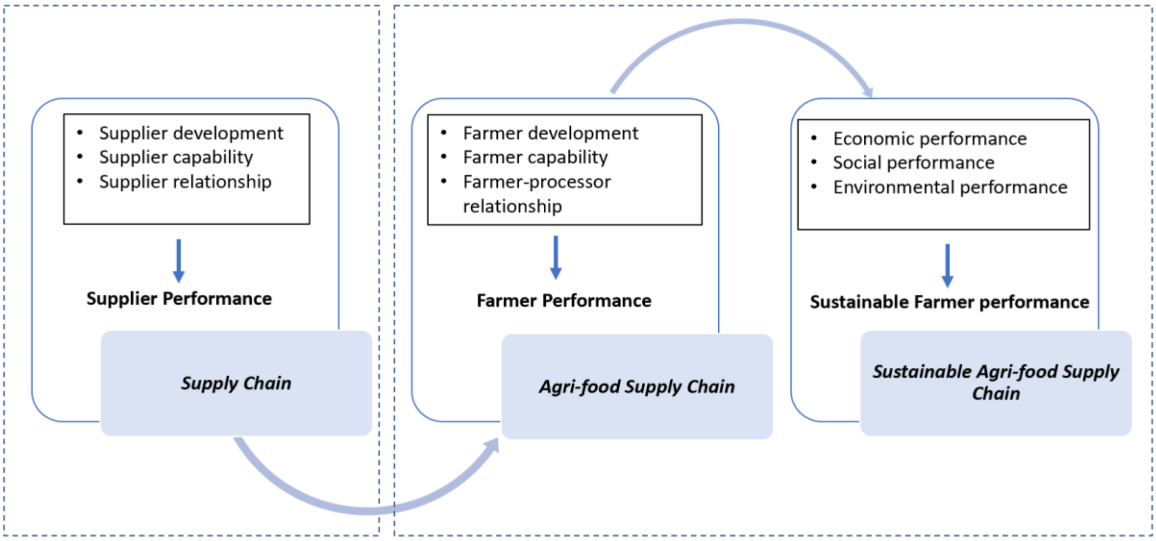



**Figure 3.1 Structure of the literature review used for proposition development**

*(Source: Own work)*

### 3.3.2 AFSC farmer development

The concept of SD is defined as all initiatives undertaken by the buyer to improve the performance of the supplier (Humphreys et al., 2004; Krause et al., 1998; Krause et al., 2007). After the term initially proposed by Leenders (1966) the 'first wave' of SD research was started by quality management researchers during 1989-91 and the 'second wave' started in 1995 when researchers started working on relationship issues (Wagner, 2006). Since the start of the ‘second wave’, few key authors have contributed significantly over the years in the evolution of SD theory and practice. One of the significant contributors to the topic of SD is Krause, followed by Wagner, Carr, Forker, Hahn, and Humphreys. All of these researchers have emphasized the importance of SD and contributed to the body of knowledge on this subject over the years. Furthermore, all of them have recommended further research to advance the knowledge for both the academic community and the industry so as to improve SC competency. Until now SD can be considered as an emerging concept in many of the article databases. For this study, the definition of SD is “Any effort of a firm to increase performance and/or capabilities to meet the firm’s short- and/or long-term supply needs” (Krause, 1997)(p. 12). will be considered. To achieve long-term strategic development goals there is an incentive for buying firms to manage and develop their supply base instead of abandoning poor-performing suppliers altogether and as a result, an increasing number of firms have started to implement SD initiatives expecting such performance improvements in a sustainable way (Jia et al., 2021). SD initiatives have been classified in literature based on different criteria and as a result, various types of SD activities exist and are mentioned by many researchers. For the study purpose, the classification of direct and indirect involvement will be considered.

Direct involvement is also named as internalized SD or broad perspective of SD in literature where a buying firm commits relationship-specific resources to a supplier plays an active role and dedicates its human and/or capital resources to a specific supplier. It covers a provision of capital resources (e.g. the financing of machines, tools, or castings used by the supplier) and activities that transfer knowledge, and qualification into the supplier's firm e.g. onsite consultation, education and training programs, temporary personnel transfer, and inviting supplier's personnel (Wagner, 2009). A buyer's indirect involvement in SD activity is often limited to setting targets/goals and monitoring the supplier with some feedback to suppliers on their performance. Both types are likely to have a direct effect on the performance of supplier and buying firms in terms of SC competitive advantage, and supplier performance improvement (Humphreys et al., 2004; Pedroso et al., 2021). It should be noted that although the direct and indirect SDs look to be distinctively different approaches to improve SD performance and they can be classified as mutually exclusive, they can also be used alongside one another (Krause et al., 1998).

Literature evidence that SD has been prevalent in the agri-food sector in developing economies (Chari et al., 2023; Mukucha & Chari, 2021), but mostly under the umbrella term of *contract farming*. The concept of contract farming was prevalent in both developed and developing countries including Greece, China, United States, and in the 20$^{th}$ century European colonial powers established formal farmer-corporate agreements in some of their colonies, but still practiced in different parts of the world (e.g., Sudan, Zimbabwe). Contract farming is an arrangement between the farmer and buyer in the AFSC to mitigate the issues faced by smallholder farmers in developing countries; contract farming facilitates smallholder market participation, improves household welfare, and promotes rural development (Meemken & Bellemare, 2020). The aspects of contract farming may include a formal agreement between the parties, providing the following: crop or livestock specifications to meet, training and education, inputs and support, price and payment specification, risk sharing, quality and quantity assurance, market access, technology adoption, and economic benefits.

**Table 3.2 Farmer development initiatives found in the literature**

| Development Effort | Working Definition | Initiatives | Sources |
|---|---|---|---|
| Direct involvement | Direct Involvement means a scenario in which a processor plays an active role and dedicates its human and/or capital resources to a farmer | Training | Bai & Satir, 2022; Brix-Asala et al., 2021; Glavee-Geo, 2019; Jia et al., 2021; Pedroso et al., 2021; Yawar & Kauppi, 2018; Yawar & Seuring, 2020 |
| | | Education | Brix-Asala et al., 2021; Glavee-Geo, 2019; Jia et al., 2021; Shukla et al., 2023; Yawar & Kauppi, 2018; Yawar & Seuring, 2020 |
| | | Transfer of implicit knowledge | Bai & Satir, 2022; Jia et al., 2021; Pedroso et al., 2021; Yawar & Kauppi, 2018; Yawar & Seuring, 2020 |
| | | Provide advice | Brix-Asala et al., 2021 |
| | | Inviting supplier personnel | Brix-Asala et al., 2021; Glavee-Geo, 2019; Jia et al., 2021; Yawar & Kauppi, 2018 |
| | | Financial assistance | Bai & Satir, 2022; Brix-Asala et al., 2021; Glavee-Geo, 2019; Pedroso et al., 2021; Yawar & Kauppi, 2018; Yawar & Seuring, 2020 |
| | | Providing materials & support services | Brix-Asala et al., 2021; Glavee-Geo, 2019 |
| Indirect involvement | In direct Involvement means a scenario in which a processor commits no or very limited resources to a farmer by offering incentives or asking the farmer to improve the performance for continuation of the contract. | Supplier rewards | Bai & Satir, 2022; Brix-Asala et al., 2021; Glavee-Geo, 2019; Yawar & Kauppi, 2018; Yawar & Seuring, 2020 |
| | | Incentives/Bonus | Bai & Satir, 2022; Brix-Asala et al., 2021; Jia et al., 2021; Pedroso et al., 2021; Yawar & Kauppi, 2018; Yawar & Seuring, 2020 |
| | | Supplier evaluation and feedback | Bai & Satir, 2022; Brix-Asala et al., 2021; Glavee-Geo, 2019; Jia et al., 2021; Pedroso et al., 2021; Yawar & Kauppi, 2018; Yawar & Seuring, 2020 |
| | | Auditing | Brix-Asala et al., 2021; Yawar & Seuring, 2020 |
| | | Supplier visits | Brix-Asala et al., 2021; Jia et al., 2021; Yawar & Kauppi, 2018; Yawar & Seuring, 2020 |
| | | Management involvement | Bai & Satir, 2022; Brix-Asala et al., 2021; Jia et al., 2021 |
| | | Transfer of employees to supplier | Brix-Asala et al., 2021; Jia et al., 2021 |
| | | Supplier certification | Bai & Satir, 2022; Brix-Asala et al., 2021; Yawar & Seuring, 2020 |
| | | Instilling competition using multiple suppliers | Bai & Satir, 2022; Brix-Asala et al., 2021 |

We also found that although SD is used as a theme in agribusiness literature, the theorizations used in SD to cover phenomena such as joint value creation in formal food value chains are founded upon the same theoretical lenses used in SD literature in SCM research. For example, based on data collected from red meat suppliers to New Zealand supermarkets, it was empirically demonstrated that the buyer-supplier relationship has a positive effect on supplier's performance (Lees et al., 2020). The article covers only information sharing as an SD initiative, but this is understood because supermarkets do not have the technical how on farming to get directly involved in activities such as training and education. In a practical application in agribusiness studies, the farmer happens to be the supplier, and the buyer happens to be the processor who can often exercise control in the SC. Consequently, in relation to our study, the buyer happens to be the processor while the supplier happens to be the farmer who supplies the commodity to the buyer. The review of SCM literature in conjunction with the agribusiness literature revealed that processors' direct and indirect involvement in developing farmers cover several initiatives as listed in Table 3.2. These initiatives will become useful (although context-specific scoping is needed) when farmer development operationalizes as a theoretical construct(s) for theory testing.

### 3.3.3 Farmer capability

Buying manufacturers need to ensure that their suppliers are capable of performing required tasks and supplying the raw material to the manufacturer in the right quantity at the right time in good quality (Yu et al., 2022). Several authors (e.g., Agada, 2014; Johnsen & Ford, 2006; Lages et al., 2009; Möller & Törrönen, 2003; Ngugi et al., 2010; Sachitra & Chong, 2018) have described different capability bases of a supplier in different contexts. In SCM literature supplier capability is defined as "the supplier's potential that can be leveraged to the buyer's advantage in the long term" (Sarkar & Mohapatra, 2006, p. 152) (p. 152). In relation to the agribusiness sector, Agada (2014) identifies learning, investment, process and technical competency, and strategic marketing as the capability bases of a supplier. However, it is worth noting that smallholder businesses often possess fewer (Ngugi et al., 2010) and narrower (Johnsen & Ford, 2006) capability bases compared to large-scale firms and could be industry-specific (Nath et al., 2010). Accordingly, in this study, we view improvement in the farmer's potential as a result of farmer development initiatives initiated by processors. By harmonizing general SCM literature on SD with agribusiness literature on farmer development, we identified three types of farmer capabilities: relationship, quality, and farmer's process management capabilities. These three capability bases can be viewed as the three different manifestations of farmer capability. It is not within the scope of our study to examine whether famer capability is a uni-dimensional construct or not.

Relationship capability is considered as a critical capability base for superior performance because the human relational capability with external parties (e.g., processors, extension service providers such as banks, training firms, relevant government authorities, non-government authorities, etc.) helps to develop knowledge, and skills, obtain support, and business know-how in the agriculture industry.

Quality capability is a concept widely used in quality management that revolves around designing a product/service right at the first time (quality of design), ensuring that the product/service conforms to standards and specifications (quality of conformance), and the product performs well when it is put into use under various use conditions (quality of performance) (Forker, 1997; Sony et al., 2020). However, such quality capability in the food processing AFSC will take the form of providing year-round supply, meeting quality standards, and implementing environmentally friendly practices ensuring sustainability and enhancing quality.

Farm process management capability in relation to our study refers to the ability of the farmer to practice and implement the knowledge gained through training programs and implement new practices or innovations to further improve farm operations. Table 3 depicts the working definitions of the three facets (dimensions) of farmer capability.

**Table 3.3 Farmer capability bases are found in the literature**

| Capability Base | Working Definition | Sources |
|---|---|---|
| Relationship | The ability of the farmer to share information, communicate, and develop long-term relationships with the processor and other stakeholders | Agada, 2014; Johnsen & Ford, 2006; Lages et al., 2009; Ngugi et al., 2010; Sachitra & Chong, 2018 |
| Quality | The ability of the farmer to design, develop, and produce products to fulfill processor requirements | Lages et al., 2009; Lakhal, 2009; Sachitra & Chong, 2018 |
| Farm process management capability | Integration of a set of tasks performed by a farm (supplier's production system) to enhance its output through the use of technology and flow of materials | Nath et al., 2010; Sachitra & Chong, 2018 |

### 3.3.4 Farmer-processor relationship

In SCM literature supplier relationship management usually consists of three stages: selecting, segmenting, and developing the suppliers. The literature on the buyer-supplier relationship has been either descriptive (describing the relationship as a process) or focused on operationalizing the buyer-supplier relationship as a construct for measurement or hypothesis testing (Benton et al., 2020). Buyer-supplier relationship as a theoretical concept was initially applied in relation to goods and service suppliers of physical goods, but later, it became an integral aspect of agribusiness literature (Pappa et al., 2019; Schulze et al., 2006). Buyer-supplier relationship in the context of our study relates to the farmer-processor relationship.

Agribusinesses processors such as dairy processors obtain their raw material (milk) from thousands of farmers whereas milk is their critical-to-quality raw material (production input). To meet the demand, processors need to manage a large supplier base to provide the raw material, although, manufacturers in other industries tend to limit the number of suppliers for critical-to-quality production inputs (Benton et al., 2020; Chavhan et al., 2018; Glavee-Geo, 2019; Wouters et al., 2007). Thus, relational exchanges in any agri-food sector are not simple because it always necessitates truly collaborative relationships for sustainable performance (Pappa et al., 2019). In maintaining such truly collaborative relationships, trust, satisfaction, and commitment were identified as the widely used dimensions of the processor-farmer relationship, hence considered for this study and discussed below.

Trust can be defined as "the belief that a party's word or promise is reliable and that a party will fulfill his/her obligations in an exchange relationship" (Balu, 1996, p. 940). Honesty, goodwill/ benevolence, integrity, and trust-competence are useful measures that could be used in agribusiness contexts (Lees et al., 2020; Moses et al., 2023).

Commitment can be defined as a “desire to continue the relationship in the future and a willingness to make short-term sacrifices to maintain the relationship” (Geyskens et al., 1999, p. 225); commitment represents the desire for the relationship to continue and the willingness to make an effort on the other party's behalf. Expectations of continuity, identification, and willingness to invest are useful measures that could be used in the agribusiness context (Lees et al., 2020).

Satisfaction the third facet of the relationship refers to a comparison between a buyer's performance and a supplier's expectations (Schulze et al., 2006). Satisfaction can be defined as the "overall assessment of the characteristics of the relationship" (Ruekert & Churchill, 1984, p. 227). Satisfaction with price, with the firm, and with communication are useful measures that could be used in the agribusiness context (Lees et al., 2020). Table 4 depicts the working definitions of the three facets (dimensions).

**Table 3.4 Farmer-processor relationship dimensions found in the literature**

| Dimension | Working definition | Sources |
|---|---|---|
| Trust | The belief of the farmers that the processor's word or promise is reliable and will fulfill the obligations of the relationship | Benitez-Altuna et al., 2023; Dania et al., 2018; de Vreis et al., 2022; Dlamini-Mazibuko et al., 2019; Kangogo et al., 2020; N. Lees et al., 2020; Moses et al., 2023; Pappa et al., 2019; Schulze et al., 2006; Schulze & Lees, 2014; Werff et al., 2018; Yawar & Seuring, 2020 |
| Commitment | The farmer's desire to continue the relationship for a long time and willingness to make short-term commitments to maintain the relationship | Dania et al., 2018; Dlamini-Mazibuko et al., 2019; Kangogo et al., 2020; N. Lees et al., 2020; Pappa et al., 2019; Schulze et al., 2006; Schulze & Lees, 2014; Werff et al., 2018; Yawar & Seuring, 2020 |
| Satisfaction | The overall assessment of the characteristics of the relationship between the farmer and the processor | Benitez-Altuna et al., 2023; Dlamini-Mazibuko et al., 2019; Kangogo et al., 2020; N. Lees et al., 2020; Pappa et al., 2019; Schulze et al., 2006; Schulze & Lees, 2014; Yawar & Seuring, 2020 |

### 3.3.5 Sustainable farmer performance – TBL performance

In 1994, John Elkington presented the TBL performance measurement framework for a business to emphasize the need for a firm to look beyond the economic dimension to cover social and environmental aspects in business accounting (Elkington, 1994). Today, the TBL concept is intertwined with the concept of sustainability. While recognizing the fact that sustainability has its roots in different cultures, disciplines, and fields of study, this attempt is to investigate the roots of sustainability in terms of TBL in the field of agriculture, paying special attention to agri-food, despite critiques surrounding (Beske & Seuring, 2014).

The Agenda 2030 declared by the United Nations is to strike a balance between the three dimensions of the TBL (economic, social, and environmental) for sustainability. The Agenda 2030 explains 17 Sustainable Development Goals (SDGs), of which the 12$^{th}$ SDG goal is dedicated to sustainable consumption and production patterns, emphasizing the need for SCs to be more sustainable. This is understandable because an SC is a bridge that links suppliers and consumers in bringing the transformed inputs to outputs to satisfy customer needs and wants. Traditionally, supplier management has focused on four operational measures of supplier performance—cost, quality, flexibility, and delivery—but now firms are paying more attention to a fifth dimension, which is sustainability (Jia et al., 2021) and this study pays attention to the fifth dimension. In our study, the scope of agricultural sustainability narrows down to the TBL performance of the farmer. Further, in a developing country context, family farming is very important because it represents a significant amount of labor, production practices, and less harmful liabilities to the environment (Zanin et al., 2020). We view economic, social, and environmental aspects of a farmer’s sustainable performance are three different concepts rather than three different manifestations of the same concept, because in practice the three facets may not move in the same direction (i.e. covary).

The economic dimension is fundamentally reflected in financial results. The performance of a farmer can be measured through production capacity and gross income, the profitability of farming, projected increase in production, and assess whether the income from farming is sufficient to meet all financial needs (Zanin et al., 2020).

The environmental dimension reflects the eco-efficiency. The dimensions refer to actions that prevent damage to the environment and can be measured in multiple ways and could depend on the type of business. However, aspects such as concern about land use, disposal of liquid waste, concern about solid waste, and air pollution are considered as main aspects (Zanin et al., 2020) related to this study.

The social dimension is related to the fair income distribution in a way that favors social inclusion, decent life and generalized access to social resources and services. Social performance (highly concerned area) can be measured through aspects such as quality of life, social well-being, and level of personal satisfaction (Zanin et al., 2020). Table 5 depicts the working definitions of each aspect of TBL performance.

**Table 3.5 Sustainable farmer performance concepts found in the literature**

| TBL Concepts | Working Definition | Dimension | Sources |
|---|---|---|---|
| Economic | A farmer’s economic performance reflects the financial results of their farm business | Production capacity<br>Projected increase in production<br>Gross income<br>Net income<br>Profitability of farming | Bánkuti et al., 2020; Beske et al., 2014; De-Pablos-Heredero et al., 2018; Meul et al., 2008; Rao et al., 2016; Zanin et al., 2020 |
| Environmental | A farmer's environmental performance reflects environmentally friendly farming practices that are being used to reduce harm to the planet. | Concern on land use<br>Disposal of liquid waste<br>Concern on solid waste<br>Concern on air pollution | Bánkuti et al., 2020; Beske et al., 2014; Hidayati et al., 2021; Meul et al., 2008; Zanin et al., 2020 |
| Social | A farmer's social performance reflects receipt of a fair income, decent lifestyle, and access to social resources and services | Quality of life<br>Occupational health<br>Personal socialization<br>Personal housing condition<br>Personal satisfaction | Bánkuti et al., 2020; Beske et al., 2014; Meul et al., 2008; Zanin et al., 2020 |

### 3.3.6 Development of propositions and theoretical model

The proposition-based concept paper is centered around a set of logical propositions that suggest cause-and-effect relationships between the constructs. In this section, we develop propositions based on the literature review to propose how farmer development leads to sustainable farmer performance. Finally, we introduce the theoretical model of the study.

#### *3.3.6.1 Farmer development as a causal antecedent of farmer capability*

Whether a buying firm plays an active role (direct SD) or otherwise (indirect SD), the purpose of SD is to increase the capability of their suppliers, so that suppliers are able to achieve the desired outcomes for the firm and the supplier (Benton et al., 2020; Brix-Asala et al., 2021; Wagner, 2009; Yang & Zhang, 2017). The agribusiness context is no exception, although the business model used by the buyer to achieve the desired outcomes may be different.

Using the dichotomy of buyer's direct involvement in SD and buyer’s indirect involvement in SD we can support the notion that direct farmer development initiatives implemented by the buying firm lead to supplier capability improvement (Benton et al., 2020; Grover & Malhotra, 2003; Wagner, 2009). Buyer's investment in knowledge-specific transactions in the form of training and education, that is asset specificity (De Vita et al., 2011; Williamson, 1979), can occur through a contractual agreement (e.g., via a formal farmer development program). Farmer development initiatives in the form of financial support to increase farmer capability can be considered as capital-specific transactions (e.g. investing in machinery, tools, etc. for the supplier) that are of specific value to the two parties only (Grover & Malhotra, 2003).

As mentioned earlier, goal-setting theory can be used to explain (in relation to farmers) to justify the processor’s indirect involvement in farmer development (Benton et al., 2020; Wagner, 2009). Indirect farmer development initiatives such as performance evaluation and feedback enable the farmer to improve their operational performance (a proxy for farmer capability). Signals such as incentives (rewards) and monitoring (with the possibility of punishment) are sufficient for a farmer to adapt to the required behavior (i.e., improved operational performance) (Benton et al., 2020). Similarly, the goal setting in the form of setting performance targets and monitoring is an effective way to motivate the farmer for performance improvement (Wagner, 2009). We acknowledge that both direct and indirect farmer development initiatives play a role in enhancing farmer capability. Direct initiatives, such as training and financial assistance, directly build farmers' skills and resources. Indirect initiatives such as supplier evaluation and feedback, indirectly influence capability by providing insights and guidance. It can be argued that this performance improvement comes about as a result of farmers becoming more capable of performing farming operations. Thus, our first proposition is:

**P1:** *Farmer development initiatives enhance farmer capability.*

*3.3.6.2 Farmer development as a causal antecedent of the farmer-processor relationship*

When the processor invests in increasing a specific knowledge resource targeting the farmer (e.g. farmer training), a high level of cooperation between the processor and the farmer becomes necessary to sustain such a farmer development initiative, because continuing such a relationship is based on the trust and goodwill between the two parties; the same can be said about providing financial support to the farmer (Benton et al., 2020; Glavee-Geo, 2019; Krause & Ellram, 1997). Further, the processors need to monitor the performance of their farmers, and when the farmer is not meeting the expected level of performance, it becomes necessary for the processor to communicate this with the farmer. The literature supports the notion that such communication results in strengthening the tie between the two parties (Tungjitjarurn et al., 2012; Wagner, 2006; Yang & Zhang, 2017; Yawar & Seuring, 2020). Thus, our second proposition is:

**P2:** *Farmer development initiatives enhance the farmer-processor relationship.*

An antithesis to P1 and P2 is that farmers who are capable and have better relationships with the processor will be identified by the processor, and these farmers will be provided with more training and development to achieve mutually beneficial outcomes (from a farmer's perspective sustainable farmer performance). In this antithesis, farmer capability and farmer-processor relationship become drivers (the causes), farmer development becomes a mediator, and sustainable farmer performance becomes the effect. This antithesis can be negated in multiple ways. One way to negate the antithesis is to argue that farmer development must occur first, and capability improvement must come after the former (i.e., the causal asymmetry) in keeping with the rationale of the concept of "supplier development". Another way to negate the antithesis is to argue that farmer capability has a more dominant effect on sustainable farmer performance than supplier development because everything a farmer does to improve their sustainable performance is a direct result of their capability, much the same way more able people can achieve better work-related outcomes (e.g., earnings) for themselves, *ceteris paribus*. Although the synthesis in reaction to the antithesis did not warrant a model modification, it highlighted that farmers who show more potential (capability, as perceived by the processor) and have a closer relationship with the processor could receive more farmer development (e.g., training and farming capital) from the processor. Since the unit of measurement/analysis of our model is individual farmers, the model accepts the reality that different farmers get different intensities of development.

*3.3.6.3 Farmer capability as a causal antecedent of the farmer-processor relationship*

A more capable farmer will be more cognizant of the action they need to take to improve their business to meet customer expectations (i.e., processor's expectations), which is necessary for sustaining improved performance. In operational excellence literature, this is known as creating a customer focus. Maintaining a closer relationship with the processor will enable the farmer to respond to any operational issue (e.g. nonconformity) more swiftly, but the farmer must have the necessary capability to know what to do to meet the buyer's expectations, which often results in a closer relationship with the buyer (Chen & Chen, 2021; Sachitra & Chong, 2018). Alternatively, more capable farmers are likely to engage in more productive and collaborative interactions with processors, leading to stronger and more positive relationships (Shukla et al., 2023). Thus, our third proposition is:

P3: *Enhanced farmer capability leads to improved farmer-processor relationship.*

*3.3.6.4 Farmer capability as a causal antecedent of a farmer's sustainable performance*

In keeping with the sustainable SD notion, farmer's sustainable performance refers to farmer's TBL performance outcomes consisting of economic, social, and environmental outcomes. The farmer's economic outcome can be represented as the farmer's income from agriculture-related activities against expenditure on both farm-related activities and household expenditure. Farmer's social outcomes can include feeling empowered and valued, being able to make social connections through family activities, and being able to improve the standard of living through farming activities (Christiansen, 2014). Such social benefits may reach the individual farmer, their family members or the workers in the farm. Farmer's environmental outcomes can be represented by achievements in mitigating the environmental impact of farming activity in terms of land use, liquid and solid waste disposal, and air pollution as a result of farming activities. However, to achieve these TBL performance outcomes, a farmer must possess the requisite capability (e.g., efficiency, new methods of farming, ability to implement knowledge gained, and ability to innovate). Finally, it is argued that the more capable the farmer (a farmer who can practice the knowledge gained from training, maintain close relationships with farm extension service providers and stakeholders, use environmentally friendly farming practices, provide around year supply in the required quantity, meet supplier's quality standards, and implement new practices to improve farm operations) more they can return a revenue over costs, make more social connections, and achieve the environmental outcomes from farming. Thus, our fourth proposition and its sub-propositions are:

**P4:** *Improved farmer capability results in sustainable farmer performance.*

**P*4a:*** *Improved farmer capability results in farmer economic performance.*

**P*4b:*** *Improved farmer capability results in farmer social performance.*

**P*4c:*** *Improved farmer capability results in farmer environmental performance.*

*3.3.6.5 Farmer-processor relationship as a causal antecedent of farmer's sustainable performance*

In the literature, the resource-based view and relational view have been used to explain why the buyer-supplier relationship has a positive effect on supplier's performance (Benton et al., 2020; N. Lees et al., 2020; Wagner, 2006). When there is a strong relationship between the buyer and the supplier, the supplier is likely to understand the buyer's requirements more closely and make a consorted effort to meet the customer's expectations (Lees et al., 2020; Shukla et al., 2023). In relation to agriculture, the farmer-processor relationship acts as social capital—a capital that the farmer can leverage to co-create value with the buyer (de Vreis et al., 2022; Lowitt et al., 2015). Sustainable farmer performance is a multi-dimensional outcome encompassing economic, social, and environmental dimensions. It emphasizes that true sustainability in agriculture should consider not only economic profitability but also social well-being and environmentally responsible practices. Positive relationships are expected to lead to improved access to markets, better pricing, and more stable demand, ultimately contributing to sustainable performance. Finally, it is argued that the stronger the farmer-processor relationship, the more likely the farmer becomes more loyal to the buyer and stick around (Dlamini-Mazibuko et al., 2019; Glavee-Geo, 2019; Lees et al., 2020; Werff et al., 2018) rather than switch to a different buyer (who does not provide farmer development) for very short-term financial gains, thus foregoing the opportunity of gaining long-term economic, social, and environmental benefits (Dania et al., 2018). Thus, our fifth proposition and its sub-propositions are:

**P5:** *Improved farmer-processor relationship results in sustainable farmer performance.*

**P5*a:*** *Improved farmer-processor relationship results in farmer economic performance.*

**P5*b:*** *Improved farmer-processor relationship results in farmer social performance.*

**P5*c:*** *Improved farmer-processor relationship results in farmer environmental performance.*

*3.3.6.6 Theoretical model*

Serving the main aim of the study, the paper used model building research design (Jaakkola, 2020) to build the theoretical model that attempts to predict and explain the relationships between the concepts under consideration. We maintain the term "concept" instead of the term "construct" because providing operational definitions (measures for theory testing) of some concepts, most notably that of Farmer Development is beyond the scope of this study (Markus, 2008). This (along with hypothesis testing involving large sample data from farmers) comes in our next study that involved engagement with farmers and processors to operationalize Farmer Development and to scope the operational definitions of the remaining concepts/constructs. As mentioned earlier, the model developed in our present study is based on the narrative literature review relating to concepts understudy taking into account the developing country context. In this study, it elaborates on the relationship among the independent variables, the dependent variables, and the mediating variables. Figure 3.2 depicts the theoretical model, with farmer development as the exogenous variable, and farmer sustainability performance as the endogenous variable. Farmer-buyer relationship and farmer capability will be considered as mediators. The mediating variables are supposed to intermediate the link between farmer development and farmer sustainable performance as shown by linking arrows.

The theoretical model accommodates the above five main propositions and sub-propositions to explain how sustainable farmer performance (farmer's TBL performance) is caused, as a result of farmer development initiatives implemented by the processor. Note that as argued earlier, we are treating economic performance, social performance, and environmental performance as three distinct concepts rather than a single concept labeled sustainable farmer performance. Our theoretical model suggests that when processors invest in initiatives that enhance farmer capability, it strengthens farmer-processor relationships, which in turn positively impacts sustainable farmer performance across economic, social, and environmental domains. These propositions and the theoretical model provide a structured framework for understanding how sustainable farmer performance can be achieved through the active involvement of processors' farmer development initiatives. The model forms the basis for empirical testing and further research in the field of sustainable AFSC in developing economies, contributing to a deeper understanding of the dynamics involved in this context.

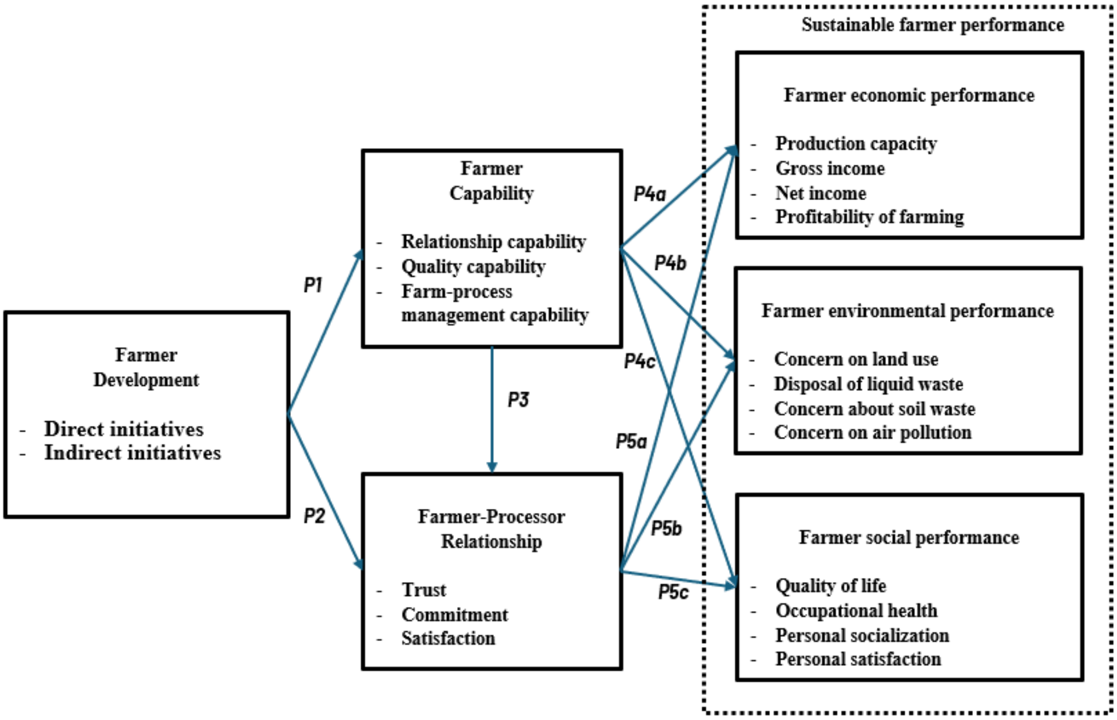



**Figure 3.2 The proposed theoretical model of the study**

*(Source: Own work)*

## 3.4 Conclusion

The study advised that an adequate theoretical framework be constructed to reflect the setting in which the paper was performed and to be operationalized and extended. We used a multidisciplinary approach by drawing on various sources of literature to construct a theoretical framework (Figure 2) that explains how farmer development initiatives implemented by the buyer (in many instances the processor) result in sustainable farmer performance (TBL outcomes for the farmer) satisfying the main aim of the study.

Our framework helps researchers in developing a comprehensive understanding of sustainable farmer development in the agri-food context. The propositions that constitute the framework suggest that farmer development initiatives result in farmer capability development (Brix-Asala et al., 2021) and improved relationships with the buyer (Yang & Zhang, 2017), which in turn, enable farmers to achieve sustainable performance in economic, social, and environmental domains. The literature suggests that farmer development initiatives implemented by the processor may take place as direct farmer development initiatives and/or indirect farmer development initiatives (Wagner, 2009), depending on the farmer. Further, the literature proposes that direct farmer development initiatives may come in the form of training and education, transferring implicit knowledge, providing advice for farming, inviting supplier farmer personnel to the buyer's factory, and providing financial assistance (Brix-Asala et al., 2021; Jia et al., 2021; Yawar & Kauppi, 2018). Providing material and support services (Brix-Asala et al., 2021) is not widely cited in the SCM literature but in certain agriculture contexts, or at least for some farmers in many agriculture contexts, this initiative may become highly relevant. The literature also refers to supplier evaluations and feedback (in an agri-food context, farmer evaluation and feedback), supplier rewards and incentives, supplier certification, and supplier visits as indirect initiatives (Bai & Satir, 2022; Brix-Asala et al., 2021; Jia et al., 2021; Yawar & Kauppi, 2018) and these may also become relevant for certain agriculture contexts. Further, the use of such farmer development initiatives may vary depending on the context, most notably, between developing and developed country contexts. These speculations as well as the tenability of the propositions themselves as a generalizable theory can only be tested with large sample data collected from the farmers. Hence, we acknowledge that the propositions outlined in the theoretical framework need empirical validation, which is the next stage of our research. We suggest that our present study provides a good foundation for testing the propositions (as hypotheses) and determining what types of direct and indirect farmer development initiatives apply in a given agriculture context (e.g., dairy farming in a chosen developing economy).

We accept that the rationale for sustainable SD is not only about improving the outcomes of the supplier (in our study, the farmer). The motive of sustainable SD is to cause TBL outcomes for multiple actors along the SC (Bai & Satir, 2022; Busse et al., 2016; Sancha et al., 2015; Zimmer et al., 2016) including the buyer. For example, there is no incentive for a processor to develop their farmers unless this results in the growth of the processor, gaining a competitive advantage, and an elevation of the processor's profile as a corporate citizen. Although we propose that farmer development leads to improved farmer capability and farmer-processor relationships, we have not proposed that these two outcomes have a positive effect on the buyer's TBL performance or the buyer's value proposition. This is because this proposition cannot be empirically tested using hypothetic-deductive methods (statistical hypothesis testing) because although there exist many farmers (each having their own capability base and relationship with their buyer) there would be only one buyer. We suggest that future research may explore supplier benefits of farmer development using alternative methodologies such as case studies. We also suggest that future research may consider the dyadic relationship between the processor (buyer) and the farmers to gain a more comprehensive understanding of the dynamics involved because our present study primarily focuses on the supplier's perspective of farmer development. Another attractive research agenda would be empirical validation of our theoretical framework in a developing country context in different AFSCs.

Finally, our study underscores the importance of a suitable business model, such as the BOP approach, for buyers such as processors to view farmer development as a strategic opportunity. Testing our theoretical framework should be conducted in such an environment.

# CHAPTER 4:
# STUDYING THE DAIRY VC OF SRI LANKA FROM THE PERSPECTIVE OF PROCESSOR-LED FARMER DEVELOPMENT

This chapter has been submitted as a manuscript to the Journal of Agricultural Sciences-Sri Lanka for peer review. Journal of Agricultural Sciences-Sri Lanka is peer-reviewed journal that provides a high-quality research forum on topical issues in Agriculture. The journal has an h-index of 4 and is indexed by Scopus, ESCI (Web of Science), DOAJ, and EBSCO. Some parts of this chapter were presented as an abstract at the International Development Studies Network (Devnet) conference themed “Shifting landscape of development- future possibilities for change”; the conference was held in Dunedin, New Zealand from 4$^{th}$ – 6$^{th}$ December 2024.

After developing the initial theoretical model (Chapter 3), the researcher had gained a sufficient understanding of the concept of supplier development (SD) and its relevance to agri-food value chains (AVCs). This understanding enabled engagement with stakeholders in Sri Lanka's dairy value chain (VC)—dairy farmers, milk processors, milk collection centers, milk collectors, senior officials, and technical officers—to examine its structure, governance, and value flow. Accordingly, this chapter presents the findings and an accompanying discussion on these three elements in the form of a value chain analysis. However, it is important to note that this chapter does not provide an exhaustive VC analysis but rather offers an analysis sufficient to support the subsequent stages of the research.

Due to word limit, some insights gained from initial fieldwork—for example operationalizing its concepts by reconciling the literature with insights from key informants—was not included in the article submitted to the journal. This excluded part, which also informs the work covered in the next chapter, is supplied as a supplementary document at the end to this chapter.

**Abstract**

**Purpose:** This paper investigates the formal dairy VC in Sri Lanka, focusing on mapping its structure, identifying its key actors, and examining the role of milk processors in driving farmer development.

**Research Method:** Semi-structured interviews were conducted with 30 key informants. Snowballing sampling was used to select the key informants. The information was analyzed using content analysis.

**Findings:** The study found that milk processors in the formal dairy VC act as the focal firms in Sri Lanka. Three main categories of processor-led farmer development initiatives were identified: farmer training, financial support, and evaluation and feedback to improve farmer performance.

**Research Limitations:** This paper used qualitative methodology and provided a sound background and context for designing a further quantitative empirical study on the topic.

**Originality/value:** There is very limited knowledge about processor-led farmer development in the context of developing economies, particularly in Sri Lanka. This study provided initial exploratory results.

**Key Words:** Dairy value chain, Processor-led farmer development, Sri Lanka

## 4.1 Introduction

Achieving sustainable agricultural development in developing economies remains a critical global challenge. Many of these nations face significant obstacles in their efforts to improve food security, foster rural development, and stabilize their economies. Central to addressing these issues is developing the agri-food value chain (AVC), which connects its actors (e.g. farmer and processor), and markets while improving the efficiency, sustainability, and livelihoods of farmers (Kilelu et al., 2017; Rahman et al., 2019; Trienekens, 2011). In VC analysis, suppliers—particularly smallholder farmers in the agri-food sector—are often considered the weakest link due to limited resources, technical knowledge, and market access (De Silva et al., 2023; Hidayati et al., 2023). Thus, the overall performance of the VC often depends on its weakest link, as inefficiencies or vulnerabilities at any stage—especially at the supplier level—can negatively impact the flow of goods, quality, and overall performance. Therefore, supplier (or farmer) development initiatives are critical for developing the VC, ensuring that all actors contribute effectively to its success (Donovan et al., 2015).

Supplier development, extensively studied in supply chain management, aims to enhance supplier capabilities to improve overall value chain (VC) performance (Krause et al., 2007; Wagner, 2009). In the agri-food sector, this concept can translate into 'farmer development,' where initiatives seek to improve the capability and performance of smallholder farmers (De Silva et al., 2023). While various authors have proposed specific development interventions relating to agri-food—such as farmer training (Aniagyei et al., 2024; Imam et al., 2021; Ladele & Kuponiyi, 2006; Mukucha & Chari, 2021), contract farming (Chari et al., 2023; Mukucha & Chari, 2021, 2024), access to credit and technology (Ladele & Kuponiyi, 2006; Wang et al., 2023; Zuza et al., 2024)—the literature remains fragmented, focusing on isolated interventions without offering a comprehensive, integrated understanding of how these initiatives collectively influence the immediate and long-term performance of farmers. Although Brix-Asala et al. (2021) contribute to the literature by addressing supplier inclusion in global supply chains, and Yawar & Seuring (2020) present broad frameworks for supplier development, these works lack the context-specific focus necessary for smallholder farmers in developing countries, especially in the absence of involvement of government or other related institutions. Additionally, they often overlooked the crucial role of buying organizations (food processors) in driving farmer development (De Silva et al., 2023). This paper addresses this gap, offering deeper insights into considering the dairy industry of a developing country as the field of study.

The dairy industry is a vital component of the agri-food sector in many developing countries as it significantly contributes to rural livelihoods and national economies (Damunupola et al., 2022; Ganguly et al., 2022; Jayasena et al., 2020; Jayaweera et al., 2016). However, this industry in developing countries differs markedly from that in developed countries mainly due to three key reasons. Firstly, in developing countries, a substantial amount of milk is often conveyed through informal channels that lack accountability, food quality, and safety (Birthal et al., 2017; Kiambi et al., 2018; Korale-Gedara et al., 2023; Nadeem & Ahmad, 2024). Secondly, the industry is inefficient, particularly on the upstream side, due to the prevalence of small-scale operators (smallholder farmers) and a lack of technical expertise (Jayasena et al., 2020; Moazzam et al., 2018; Nguyen et al., 2018; Nyokabi et al., 2018). Thirdly, there is limited availability of resources and support services, such as infrastructure, transportation, technology, finance, and institutional support (Khairallah et al., 2023; Tadesse, 2016; Trienekens, 2011; Wijethilaka et al., 2018). These factors highlight the need to develop the dairy VC to involve well-structured and governed processes from production to consumption. Thus, mapping the VC, and identifying its key actors, their roles and relationships is essential for optimizing operations and fostering farmer development to develop the VC (Donovan et al., 2015; Hitihamu et al., 2021; Nyokabi et al., 2018).

Within the dairy VC, milk processors are considered pivotal in developing the VC because they serve as key value-adding actors once the milk leaves the farm gate (Hitihamu et al., 2021; Nguyen et al., 2018). To remain efficient and competitive, these processors strive to enhance the capability and performance of the weakest party–dairy farmers (De Silva et al., 2023; Donovan et al., 2015). Accordingly, this study explores the specific contributions of milk processors in supporting smallholder farmers through development initiatives. In the Sri Lankan context, this is especially relevant, as other actors in the dairy VC have limited involvement in developing smallholder farmers. By focusing on milk processors, this study provides insights into how this key actor can strengthen the VC by improving the sustainable performance of suboptimal dairy farmers.

Sri Lanka's dairy sector entails over 300,000 smallholder farmers, who produce only 40% of the country's milk supply (Damunupola et al., 2022; Vidanarachchi et al., 2019). This suboptimal milk supply prevents milk processors from reaching their designed capacity. The situation has placed a huge burden on dairy imports that amount to over a value of $300 million annually (Damunupola et al., 2022; Vidanarachchi et al., 2019). Developing the VC and enhancing this sector to achieve self-sufficiency in milk production is essential for improving rural livelihoods and national food security (Perera & Jayasuriya, 2008; Korale-Gedara et al., 2023; Priyashantha & Vidanarachchi, 2024). As the key player in the VC, milk processors can play a major role in developing the VC through development interventions (Kajananthan & Achchuthan, 2012; Nguyen et al., 2018; Viet Khoi & Dung, 2014). However, these context-specific challenges must be addressed with a thorough understanding of the dairy VC's mechanisms and systems (Jayaweera et al., 2016; Wijethilaka et al., 2018). Although milk processors have the potential to support farmers through development interventions that could reduce the gap in milk production and help them reach their full processing capacity, the role of processors in enhancing farmers' value-creating capabilities in Sri Lanka has been largely overlooked by researchers. Accordingly, this paper aims to map the formal dairy VC to identify the key actors and to examine the role of milk processors in dairy farmer development within the Sri Lankan context.

This paper is important in three ways. Firstly, mapping the formal dairy VC and VC players provides a framework for analyzing the flow of products across various stages of the VC. This analysis also reveals the intricate relationships and dependencies that influence the industry's efficiency and effectiveness. Secondly, the study emphasizes the pivotal role of milk processors in the formal milk channel, exploring ways to support dairy farmers through development initiatives. The focus on such processor-led farmer development initiatives is crucial for improving the capabilities and performance of dairy farmers in a developing country. Thirdly, the study provides implications for academia, practitioners (milk processors), and policymakers. The study is important for academia because it identifies the key role being played by milk processors in developing dairy farmers and the existence of three categories of development initiatives in a Sri Lankan dairy value chain context. It also paves the way for future explanatory studies. The study is important for milk processors to identify their role in managing dairy farmers. The study is important to policymakers to put systems in place to motivate practitioners to take farmer development more seriously.

The remainder of this paper is structured as follows: Section 4.2 reviews the relevant literature. Section 4.3 explains and justifies the approach employed. Section 4.4 presents the empirical results and discussion. Finally, Section 4.5 concludes the study, outlining key implications, limitations, and suggestions for further research.

## 4.2 Literature review

### 4.2.1 Agri-food VC

The concept of VC was initially put forward by Porter (1985) as a strategic management concept to explain how a firm creates value through interconnected activities and processes. The concept started significantly appearing in agri-food literature in the early 2000s and since then, VC analysis has become an important tool in agri-food literature to assess efficiency, competitiveness, and sustainability in agriculture. For this study, an AVC is identified as the interconnected network of activities, actors, and processes involved in bringing agricultural products from the farm to the consumer, often termed the 'sequence of activities from farm to fork' (Donovan et al., 2015). VC analysis helps to identify not only the stages where customer value can be increased but also the nature of business relationships with various stakeholders along the chain. Accordingly, in this study, for the VC analysis, the author has characterized the VC by its network structure, governance form, and the value addition that occurs at different stages (Cucagna & Goldsmith, 2018; Hidayati et al., 2021, 2023; Tray et al., 2021; Trienekens, 2011).

Taking the supply chain management perspective, this study looks at the vertical dimension of the network structure–the connection between the two actors–farmer and processor. Today, in this network structure, business organizations are going beyond the economic considerations to maintain relationships with other organizations that enhance the social capital of the organization, providing more room for information sharing, transfer of technical know-how, and providing financial support (Burt, 2009; Trienekens, 2011).

In such a network structure, AVC governance refers to the system of coordination and control processes that regulate how activities and relationships among the actors are structured and managed (Donovan et al., 2015; Mishra & Dey, 2018; Trienekens, 2011). It determines who holds power in the chain, who makes key decisions, and how resources and benefits are distributed among the actors. VC actors are the individuals or entities involved in the various stages of the agricultural process (Hidayati et al., 2021; Hitihamu et al., 2021; Tadesse, 2016). Governance also includes information flow where efficient information flow between the farmer and processor enables better traceability and performance improvement (Trienekens, 2011).

In a VC, the value addition can happen at different stages by various actors, not in isolation but as members of the chain (Cucagna & Goldsmith, 2018; Porter & Advantage, 1985; Trienekens, 2011). The stages of agri-food value-adding activities include farm production, processing, and delivery to customers (Cucagna & Goldsmith, 2018; Hidayati et al., 2023). In a dairy VC, the value addition can happen at the farmer stage (farm production stage) but mainly at the milk processor stage (processing stage) (Nguyen et al., 2018; Rahman et al., 2019). The key elements of value addition in agri-food can be specified as quality, safety, and value orientation (Hidayati et al., 2021). The size of the value added is decided by the end customer's willingness to pay.

In this respect, developing country's AVCs are subject to many uncertainties caused by poor physical infrastructure (cold chain transportation, storage facility, and telecommunication), weak institutional infrastructure (support from government and other related institutions), limited access to resources (lack of know-how, financial support, inputs, and support services), and unbalanced trade relationships (heavy dependency on intermediaries and opportunistic behaviors of buyers) (Hitihamu & Karunarathna, 2022; Trienekens, 2011). These often cause inefficiencies or vulnerabilities along the VC, negatively affecting the weakest actor the most, resulting in low performance at the farm level (Hidayati et al., 2023; Jayasena et al., 2020; Nguyen et al., 2018). As a result, smallholder farmers often lack bargaining power, are incapable in value addition, and need support (Donovan et al., 2015; Mishra & Dey, 2018).

When a farmer is incapable of adding the processor's expected value to the produce at the farm production level, a competitive milk processor has an obvious incentive to develop the capability and performance of its farmers aligning the key value elements to meet customer value expectations (De Silva et al., 2023; Donovan et al., 2015; Khairallah et al., 2023; Mukucha & Chari, 2021). Yet, in a vertical relationship, the processor becomes the key player (focal firm) of the VC—who holds the governing power to control and make decisions on providing the required support to develop the incapable farmer (Kajananthan & Achchuthan, 2012; Khairallah et al., 2023; Mukucha & Chari, 2021; Trienekens, 2011). In a situation like dairy (which is a highly perishable agri-food product with a short life cycle), while ensuring its competitiveness a milk processor as the focal firm has to play the middle role between promoting the growth of the sector by offering the market to dairy farmers (purchase raw milk by establishing milk collecting centers or aggregating with collectors) and providing value-added products to end customers focusing on milk quality control, safety, value orientation, market expansion and distribution (Kajananthan & Achchuthan, 2012; Nguyen et al., 2018; Trienekens, 2011). Accordingly, the authors of this paper argue that the development interventions of a processor as the focal firm of VC will generate numerous benefits. These interventions will not only improve the profitability, competitiveness, and long-term sustainability of the milk processor but also improve the sustainable performance of farmers by improving their value-creating capability. Furthermore, they will strengthen the relationship between the farmer and processor within the vertical structure, extending beyond the economic considerations to enhance social capital thereby developing the VC (Arshad et al., 2024; De Silva et al., 2023; Donovan et al., 2015; Kumar & Tripathi, 2012).

### 4.2.2 Processor-led farmer development

In supply chain management theory, the interventions of a buyer (the focal firm) to enhance the performance and capabilities of the supplier are identified as 'supplier development' (Krause et al., 2000; Wagner, 2009). The concept also highlights that buyers establish such development interventions to achieve the buyer's strategic business and operational goals, such as gaining a competitive advantage. The paper applies this theory to the agri-food context, where the buyer is the milk processor and the supplier is the dairy farmer, introducing the concept of 'processor-led farmer development". The literature on supplier development, when applied to farmer development, suggests a range of initiatives that a processor can implement, depending on the situation. Of the vast array of development initiatives proposed by researchers relating to AVC in developing countries (e.g., Aniagyei et al., 2024; Brix-Asala et al., 2021; Chari et al., 2023; Imam et al., 2021; Ladele & Kuponiyi, 2006; Mukucha & Chari, 2021; Wang et al., 2023; Yawar & Seuring, 2020; Zuza et al., 2024), the authors of this study will look at three broad themes/categories: farmer training (transfer of technical know-how), financial support, and evaluation and feedback on farmer performance (information sharing) those can ensure VC development (Burt, 2009; Donovan et al., 2015). For this study, the author defines 'farmer training' as ways of providing training and education to a dairy farmer in the form of knowledge transfer and technical know-how resulting in improved skills and capabilities (Aniagyei et al., 2024; De Silva et al., 2023; Ladele & Kuponiyi, 2006; Thakur et al., 2022). 'Financial support' is a way of providing monetary support and rewards, material, machinery, or equipment to improve the dairy farm business (Chopde et al., 2019; De Silva et al., 2023; Mukucha & Chari, 2021). Capturing the information-sharing aspect and with special reference to dairy, the author of this study defines 'evaluation and feedback to improve farmer performance' as sharing information on evaluation and feedback on farmer performance (Brix-

Asala et al., 2021; De Silva et al., 2023; Ladele & Kuponiyi, 2006; Yawar & Seuring, 2018). One of the strategic tools that are used in VC analysis for VC development is VC mapping. VC mapping is suitable for VC development because it employs a significant platform that includes a specific agenda on the process, actors, and value-added (Hidayati et al., 2021). Since current practices should be scanned to identify both actors and systems that urgently require development, this study will employ VC mapping followed by an exploration of the effectiveness of processor-led farmer development initiatives under three broad categories, highlighting development opportunities.

### 4.3 Case study application

#### 4.3.1 Description of the case study area

Sri Lanka has the potential to meet most of its dairy needs through local production due to its favorable geography, manageable population, and low domestic milk consumption (Jayaweera et al., 2016). Based on the Food and Agriculture Organization (FAO) (Morgan, 2008), the per capita milk consumption of Sri Lanka in the year 2000 (newer, reliable data not available) stood at 33kg, which is lower than the averages of Pakistan's and India's 180kg and 79kg respectively. However, as of 2023, only about a third of the country's milk needs are met locally, in spite of more than 300,000 registered cattle farms having about one million milk-yielding cows (Department of Animal Production and Health, 2023; Korale-Gedara et al., 2023; Vidanarachchi et al., 2019). To resolve the shortfall, milk is imported in the form of milk powder placing a significant burden on the national economy (Marambe et al., 2017).

Sri Lanka's dairy market comprises informal and formal sectors (Vidanarachchi et al., 2019). Despite the expectation of growth, the formal VC is still underperforming due to several underlying issues: quantity and quality shortfalls of silage (cattle feed), poor dairy management practices, inadequate extension services, lack of national milk quality standards that align with international standards, and insufficient milk chilling facilities (Sullivan, 2020; Vyas et al., 2020). These gaps in the VC directly affect the ability of the weakest party in the chain–farmers to increase their output and quality, leaving processors with insufficient milk supply (Donovan et al., 2015).

Currently, there are about 21 major milk processors (firms that collect milk and add value through different products) in Sri Lanka. A notable aspect of milk processing in this country is that all major dairy processors operate below capacity because the expected increase in milk supply, for which the processing plants were originally designed, never occurred (Vidanarachchi et al., 2019) hence farmer section for milk supply has beocme infeacible. Processors, therefore, stand to benefit directly from initiatives that help farmers to increase production.

Public, private, and non-profit sectors have been providing agricultural extension services to varying degrees in Sri Lanka since 1920 (Wanigasundera & Atapattu, 2019). The public sector offers agricultural extension as a social development initiative, the private sector do so for profit, and NGOs do it for community empowerment (Jayasinghe, 2020). However, these efforts are not only inadequate but poorly implemented. Therefore, milk processors, as the focal firm of the VC who add substantial value to the product to meet end customer value, are uniquely positioned to develop their low-performing farmers, improve their efficiency, competitiveness and develop the entire VC (Khairallah et al., 2023; Kidd et al., 2000; Suvedi & Sasidhar, 2020; Vyas et al., 2020).

Sri Lanka's substantial formal milk market (about 56%), compared to countries like Pakistan (about 10%), Bangladesh (about 15%), and Kenya (about 20%) presents a promising opportunity for such processor-led development activities for VC developing (Korale-Gedara et al., 2023; Rahman et al., 2019). However, there is a notable lack of research on the role of processors in enhancing farmers' value-creating capabilities in Sri Lanka and how supporting farmers through capability building, the processors could help reduce the gap in milk production and meet their full processing potential.

### 4.3.2 Case study methodology

The research adopted a qualitative case study approach. The exploratory research design with a wider range of key informants is used since not much is known about the phenomenon of interest (Bryman & Cramer, 2012; Lokot, 2021; Rosairo, 2024). The theoretical basis for designing the interview questions for the key informants is based on the synthesis of De Silva et al. (2023), who propose when farmers are developed to improve their business that will result in improving value-creating capability and sustainable performance of farmers. The actors along the upstream of the VC were considered for this study. Interviews with people who possess phenomenon-related experience (key informants) are considered, and this allows them to provide detailed and nuanced information (Creswell & Creswell, 2017; Lokot, 2021). The data collection took place during January to April 2022.

Snowballing sampling was used in identifying the participants. This sampling method was useful when gathering data from a fragile population, as samples needed to be collected using a multiple-stage process within a social context (Naderifar et al., 2017). As shown in Table 01, this resulted in recruiting 30 key informants to reach data saturation (Creswell & Creswell, 2017). In this study, interviews were used as the primary source of data collection, and observation and secondary data such as recordings and photographs were collected and used to ensure construct validity by triangulating between diverse sources. The semi-structured interviews were designed for 60–90 minutes and recorded using a voice recorder (with the permission of the interviewee) for analysis purposes. The interviews were assisted by a questionnaire to obtain in-depth context understanding, and specific questions on farmer development. The principal investigator (corresponding author) verified the credentials of the informants to ensure that they were fit for purpose. This research used the human ethics guidelines of the authors' university, based in New Zealand. The qualitative data collected from the interviews were analyzed using content analysis. This approach involved describing, classifying, and connecting concepts for the overall account (Creswell & Creswell, 2017; Dey, 2003).

**Table 4.1 Profile of interview participants**

| VC actor | Method of data collection | Number of interviews |
|---|---|---|
| Senior officials and stakeholders | Semi-structured face-to-face interview/ video conference | 5 |
| Milk processors | Semi-structured face-to-face interview/ video conference and secondary data | 4 |
| Milk collecting centers | Semi-structured face-to-face interviews, observations, and secondary data | 3 |
| Dairy farmers (small-medium scale) | Semi-structured face-to-face interviews, observations, and secondary data | 11 |
| Dairy farm (large scale) | Semi-structured face-to-face interviews, observations, and secondary data | 1 |
| Milk collectors | Semi-structured face-to-face interviews, observations, and secondary data | 6 |

The milk processors interviewed varied in terms of ownership, including private, government, and multinational entities, and ranged in scale from small to large. The criteria used to select dairy farmers included: that they supply more than 50% of their milk to the identified milk processor and confirm that they are being supported by their milk processor in various ways to improve their outcomes.

## 4.4 Results and discussion

The results and discussion are presented in two categories: VC mapping and farmer development.

### 4.4.1 VC mapping

The diagram in Figure 01 presents key actors, including farmers, collectors, milk processors, distributors, and retailers. The imported milk quantity—almost invariably in milk powder form—is added last to highlight the percentage of imported milk (about 60% of the total demand) (Marambe et al., 2017). The imports may come as an injection to the milk processor where the processor makes some value additions (e.g., transform the powdered milk to liquid milk) and present to consumers (individual consumers or to commercial customers like hotels and restaurants) or directly to the consumer (e.g., with no value additions). The primary activities/processes in the VC include production, collection, processing, distribution, and retail. Large, small, and medium-scale farmers were involved in production. Milk processors (through their own collecting centers) and intermediaries such as farmer-managed society centers (FMSCs), cooperative society collecting centers (CSCCs), and other intermediary collectors were performing as milk collectors who collect milk from the farmers. The actors along the downstream of the VC (distributors and retailers) were not further analyzed because they are out of the scope of this study. The roles and characteristics of each actor on the upstream are discussed below.

The black solid line represents the formal channel, while the grey dotted line illustrates the informal channel. At the farm level, milk enters the informal channel through smallholder farmers (about 15.6%). During the collection stage, some percentage of milk enters the informal channel and re-enters the formal channel via intermediary milk collectors, although the exact volume of this leakage is unknown. In addition, general leaks/losses take place at each stage of value addition (e.g. self-consumption, product nonconformance, processing losses). Despite these significant losses, they are currently unaccounted for by those responsible for managing the efficiency of the formal VC.

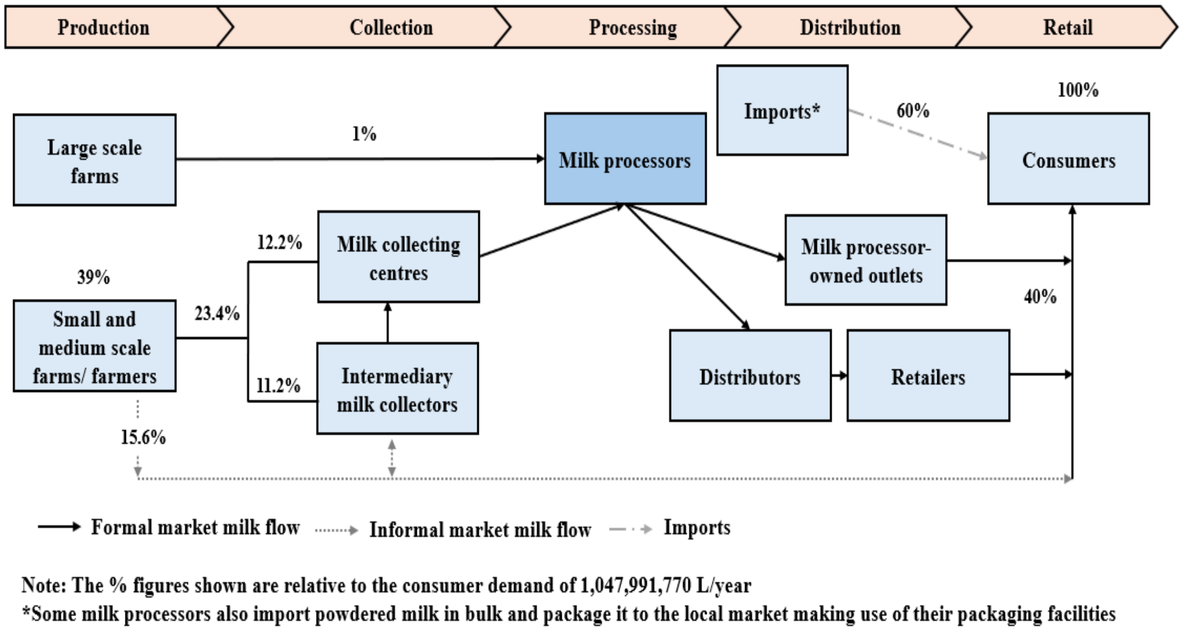



**Figure 4.1 Dairy VC with approximate % of milk flows**

*(Source: Own work)*

*Small and medium-scale farms/farmers* – As evidenced in Figure. 01, the majority of producers are small (<10 milk-yielding cows) and medium-sized dairy farmers (10-40 milk-yielding cows). Although the World Bank defines smallholder farmers as those who work on a plot of land, it was found difficult to use land area as a criterion for Sri Lankan farmers (Jayasena et al., 2020) hence the number of cows employed in this study (FAO, 2024; Vidanarachchi et al., 2019). During the interviews, it was found that Sri Lankan milk processors also follow a number of cows or milk liters (L) produced for their farmer categorization purposes. For this study, the term smallholder, representing both small and medium-scale farmers, will be used hereafter. Of the production by smallholders, the majority of the milk (23.4/39 = 60%) is transferred to the formal channel, where farmers operate as registered suppliers to a specific milk processor. Farmers receive payments from the milk processor based on the Milk fat (FAT) and Solids-not-fat (SNF) counts recorded and maintained at the milk collection center (Korale-Gedara et al., 2023). Immediately before releasing the milk into the channel, farmers perform basic physical quality checks, such as visual inspection (unusual color or texture) and smell of the milk (Korale-Gedara et al., 2023).

*Large-scale farmers (over 40 animals)*– They produce about 1% of the country's milk supply. These large-scale dairy farms work directly with the processors (on an annual contract basis) where milk produced is directly collected by the respective milk processor’s large milk tankers (6000L tankers) and transported to the processing plant. Before releasing the chilled milk into the channel, FAT and SNF counts (using electronic milk analyzers), and other quality checks (such as microbiological tests and antibiotic residue tests) are performed. In the interview, it was revealed that when it comes to processor-led development interventions, these large-scale farms were found performing independently and can develop themselves, hence not further considered for processor-led farmer development discussion in the next section.

*Milk collecting centers*– The important point highlighted here is that dairy collection centers are often established by milk processors, with minimal third-party involvement in the conveyance of milk. These collection centers receive nearly 12% of the milk that enters the formal channel, which is transported directly by farmers (on foot or by bicycle), or in some cases, the milk processor's vehicle collects the milk from the farm gate or FMSC. Additionally, only in certain areas, third-party bulk suppliers collect milk at the farm gate and transport it to the collection center (this will be discussed further under other intermediaries). It was revealed that strategies used by milk processors to optimize the milk supply in the upstream segment (between farmer and milk processor) were context-specific, meaning different processors used slightly different methods at different collection centers. The dominant method(s) depended on the region/district and the proximity between the farmer and the collection center. In general, the results show that milk processors are trying to maintain a shorter chain (with fewer parties involved) to ensure that less time is spent in an uncontrolled temperature environment. Upon receipt of the milk, physical checks such as visual inspection (unusual color or texture), smell test, and temperature are performed before accepting the milk for chilling. Thereafter, FAT (often using the Gerber method), and SNF (lactometer) counts take place and if the SNF value is above or below the normal level (between 8%-9%), a milk adulteration test (detection of water content) was conducted. During the interviews, it was found that one milk processor is conducting an 'antibiotic residue' test at the milk collecting center and if the presence of antibiotics is detected, the milk will be discarded to the septic tanks at the collecting center.

*Other intermediaries*–In some areas, CSCCs, FMSCs, and other intermediary collectors are involved in milk collection (about 11% of milk enters the formal channel). The functioning of other intermediary collectors was context specific. In certain areas, they act as secondary collectors, contracted by processors to collect milk at the farm gate and transport it to the processor's collection center using a lorry. In other areas, intermediary collectors act as merchant intermediaries, buying milk at the farm gate and selling it to the processor's collection center. In addition, individual farmers deliver and sell milk to third-party collection centers, and secondary collectors, in turn, transport the milk using a lorry to the processor's collecting center. These transport methods found the common issue of milk contamination. Often in these cases, one container (milk can) collects milk from many farmers, with no milk quality checking or temperature maintenance happening until it reaches a milk processor's collecting center. This is a major cold chain issue also identified in other similar countries like Bangladesh and Pakistan that milk processors are trying to discourage (Kang'ethe et al., 2020).

*Milk processors*– Chilled milk is then transported to processing plants, where significant value addition takes place. Upon arrival at the processing facility, milk undergoes further quality tests similar to those at the collection centers, but with more advanced laboratory equipment. Comparatively, this was similar to other South Asian countries (like India, Pakistan, Bangladesh, and Nepal) where FAT and SNF tests are a common thread, but the degree of automation and sophistication varies. For instance, India leads with the more widespread use of automated analyzers, whereas other countries rely more on simpler methods like Gerber tests and lactometers. The use of microbiological tests to measure the bacterial load in milk was not found commonly in milk collecting centers but at the few large-scale processors at the processing plant. Milk adulteration testing (detection of water content in milk) in Sri Lanka was similar to that of other countries like Bangladesh, Nepal, and Pakistan, whereas India was stepping ahead in looking for detergent and chemical contents (Korale-Gedara et al., 2023; Nadeem & Ahmad, 2024).

At the processing plant, value-added products such as pasteurized or ultra-heat-treated (UHT) milk, yogurt, butter, and cheese are produced and then distributed to customers through agents and retail outlets. Interviewees in this study explained that all processors use Hazard Analysis and Critical Control Point (HACCP) as a food safety management system at their processing plants, in compliance with Food Act no. 26 of 1980 and standards enforced by bodies such as Sri Lanka Standards Institute and Ministry of Health (Jayasinghe-Mudalige et al., 2015; Korale-Gedara et al., 2023). Further, the results of this study revealed that some large-scale milk processors employ a sizable number of extension officers to bridge the gap between the farmer and the processor, fostering closer relationships. These extension officers also provide feedback to smallholder farmers on milk hygiene, milk quality, and milk productivity (more about these will be discussed later).

The existence of both formal and informal channels was similar to other countries like India, Pakistan, and Bangladesh (Kumar et al., 2022; McKague & Siddiquee, 2014; Sattar, 2020). But in Sri Lanka flow of milk in the formal channel is comparatively high and notably a greater part of the formal VC is vertically integrated (Korale-Gedara et al., 2023; Trienekens, 2011) meaning a direct and close relationship between farmers and milk processors (milk processors' collecting centers) with low involvement of intermediaries. However, Sri Lankan formal VC is heavily relying on smallholder farmers as evident in Figure 4.1.

The mapping of the VC shows the prominent role played by milk processors as the focal point of the chain where all the milk comes for value addition. Apart from production at the farm, neither the farmer nor any intermediary is involved in value addition until the product flows to the milk processor's processing plant for significant value addition. Most of the farmers interviewed confirmed that they are not involved in value-additional activities other than repurposing–using waste (e.g. cow dung) as an input (fertilizer) for their other agriculture activities (e.g., vegetable, fruit farming, and home gardening). This is similar to VC in Pakistan where private dairy companies are the dominant value-adding actors in the formal sector who govern milk collection, quality testing, processing into value-added products (UHT milk, yogurt, butter), packaging, and distribution (Haq, 2012). However, this is somewhat different from other countries such as India and Nepal where dairy cooperatives play a significant value-adding role compared to private processors. For example, in India, a dairy cooperative like Amul has a cooperative governance model that empowers smallholder farmers while ensuring efficiency in milk processing and marketing (Jha & Gupta, 2020). Comparatively, in Sri Lanka, it was found that dairy cooperatives contribute to the collection but are less involved in extensive value-adding processes compared to private companies.

As regards the question of which actor in the upstream of the VC is most important to the processors—farm input suppliers, farmers, FMSCCs/CSCCs, and other milk collectors—all the processors said that the farmer is the most important factor to them. For the question of who needs to be developed, all the processors revealed that the farmer is the weakest but the most important party to be developed. This finding is similar to the VC analysis done for similar contexts like India, Bangladesh, Vietnam (Jha & Gupta, 2020; Rahman et al., 2019; Viet Khoi & Dung, 2014). All the processors expressed the view that the involvement of intermediaries between processors (milk collecting centers) and farmers needs to be reduced and eventually eliminated obtaining more room to directly connect/ maintain close relationships with farmers. The use of digital platforms to share information, the use of extension officers, the expansion of the milk collection network with proximity to farmers, and the implementation of company-led milk transport systems are some of the strategies that processors are implementing to reach said target of ensuring direct involvement with the farmers. Similar context-specific strategies were also recommended by Rahman et al. (2019) for Bangladesh and Haq (2012) for Pakistan.

For a similar question to the farmers regarding the most important actor, all the farmers confirm that it is primarily the milk processor—often through the processor's milk collecting center—who provides the most support to the farmers to improve their business hence the most important actor. Apart from the milk collection center, there are village societies, rural banks, cooperative societies, non-government organizations, field officers, veterinary centers, milk agents, and transporters who are some of the parties with whom the dairy farmers maintain relationships in day-to-day business transactions (also identifiable as stakeholders of the farm business) (Nyokabi et al., 2018). However, from the farmers' point of view, it is primarily the milk processor (through the milk collecting center) that provides them with the most support. Farmers believe that milk processors (milk collecting as the hub/central point) are often involved in providing benefits and creating links with other parties that farmers find hard to reach (e.g., veterinary support, artificial insemination, access to credit, training through input suppliers, and NGOs). Interestingly, one of the farmers said, *"My milk processor acts as a hub/central location who coordinates other parties to provide support for us…."* indicating the extended scope of some milk processors. This is also in line with the VC analysis done for Pakistan and Vietnam (Nguyen et al., 2018; Viet Khoi & Dung, 2014) who identified that the milk processor is the center and also the ruler of the dairy VC in developing countries. Conversely in India, Nepal, and Bangladesh, it is the dairy cooperatives and NGOs who play a significant role in supporting farmers rather than the private milk processors.

The VC analysis through VC mapping confirmed that the milk processor is the key actor involved in the main value-adding in dairy VC in Sri Lanka. The processor holds significant power to govern the coordination and control of the process along the dairy VC. In aligning with the existing literature (e.g., Donovan et al., 2015; Mukucha & Chari, 2021), the findings further highlight that the Sri Lankan dairy VC is heavily reliant on the smallholder farmer–arguably the weakest actor along the chain–who requires development support. This VC configuration confirms the existence of a vertical network structure between the farmer and the milk processor. In such a network structure, the buyer (milk processor) is in a unique position to provide the necessary development support to enhance the capability of smallholder farmers thereby developing the VC (Donovan et al., 2015; Mukucha & Chari, 2021).

### 4.4.2 Farmer development

*4.4.2.1 Availability of the concept of farmer development*

After mapping the dairy VC, the focus shifted to exploring development support provided by the milk processors in Sri Lanka (processor-led farmer development). Interviews and available secondary data (e.g., record book given by milk processor to maintain dairy milk supply records, booklets from milk processors about dairy farm management, and records of attending training programs conducted by the milk processor) corroborated that farmer development does occur to varying degrees, to improve farmer capabilities and sustainable performance for mutual benefit. While all processors provided some development initiatives to farmers, only one of them had a very systematic selection approach in choosing ‘potential farmers’ for their development programs. The farmers with at least 6-7 cows, producing milk 20L-30L or above, owning at least 1 acre of land with the potential to improve as entrepreneurs were considered as potential participants for their development program. The program was designed to develop farmers on a step-by-step approach to reach the target of 100L per day by transforming them into entrepreneurs. In contrast, another milk processor was directing their support to those farmers who requested help, giving special preference to the small-scale farmers as they do not have the capacity to develop by themselves independently.

The data demonstrated three categories of processor-led farmer development: farmer training (FT), financial support (FS), and evaluation and feedback on farmer quality performance (EFFQP). The responses received for questions of ‘What support do you provide to your farmers to improve their business? and describe as much as possible’ (from processors) and ‘what support do you receive from your milk processor to improve your business? and describe as much as possible’ (from the farmer) were given in Figure 4.2.

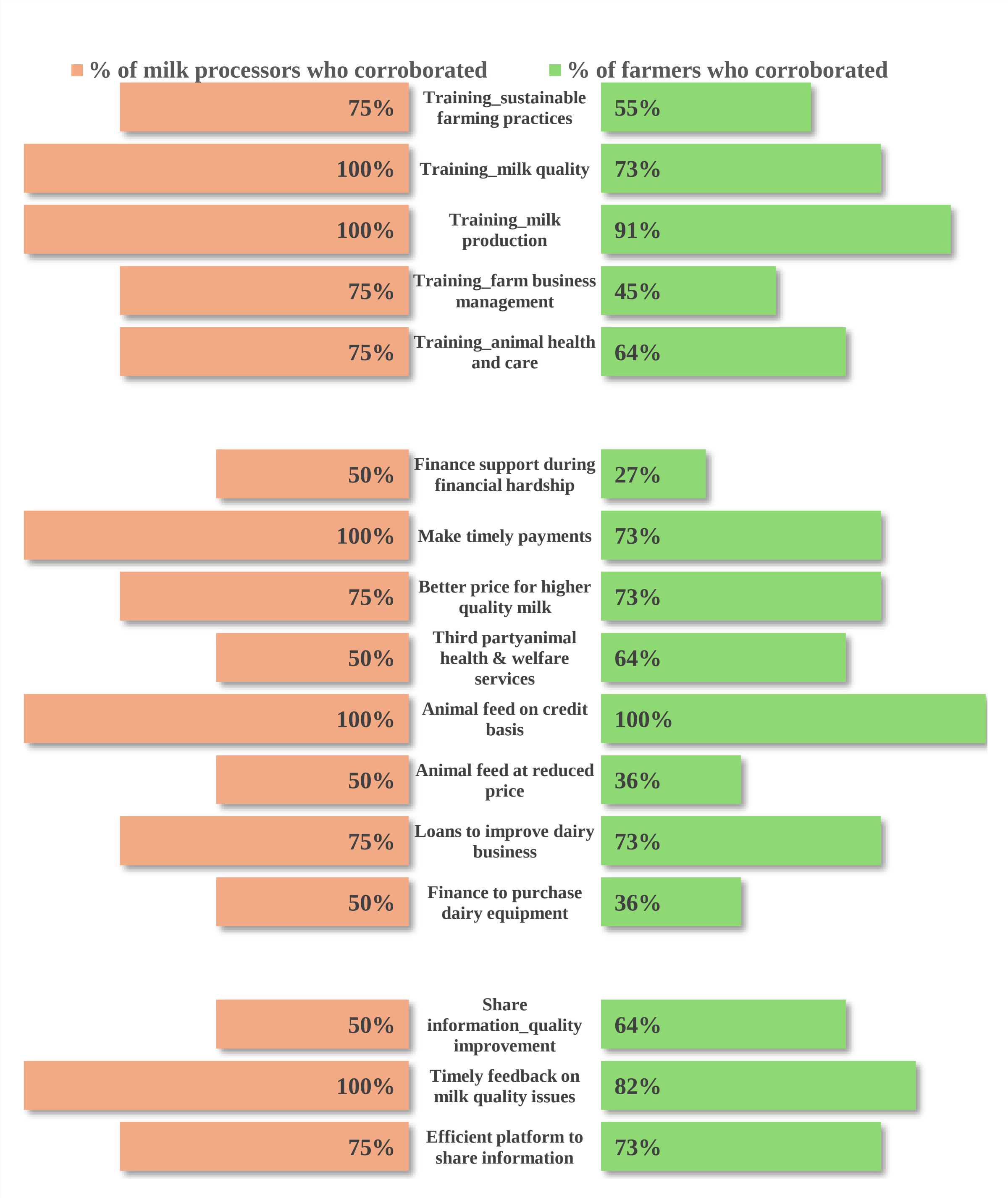



**Figure 4.2 The butterfly chart showing the agreement rates on different indicators of 'farmer development'**
(Source: Own work)

*4.4.2.2 Farmer training (FT)*

As shown in Figure 4.2, all four milk processors and their farmers agree on training as a development initiative, in varying degrees or aspects. Training provided on milk production and milk quality assurance were identified as the most widely used. One farmer said, *"We* *receive instructions on animal feeding, hygienic milk drawing, and the correct way of drawing milk from the cows…, and at least there are three such training sessions per year…., and my milk processor provides booklets for me to read and upskill myself ".* These responses tally with farmer development initiatives prescribed in the literature for developing economies (e.g., Aniagyei et al., 2024; Brix-Asala et al., 2021; De Silva et al., 2023; Thakur et al., 2022) and specifically for food safety in the dairy sector in Sri Lanka (Korale-Gedara et al., 2023). The authors of the present paper consider training and providing advice to improve quality and productivity as a critical farmer development initiative in terms of knowledge transfer.

More in-depth analysis of the responses of the milk processors and farmers revealed that formal training sessions or programs may take place at the milk processor's premises (e.g., at the milk collecting center), at a model farm (e.g., Bopaththalawa, which is a large-scale farm), or at a selected farm in the village (e.g., the so-called 'champion milk producer' in the village). These training programs are conducted either by the milk processor (e.g., via an appointed development officer/s of the firm or a skilled employee in one of the firm's milk-collecting centers) or by a contractor employed by the processor. From the interviews, it was found that the most popular method currently used is formal training sessions conducted at the milk collecting center by the milk processor via a skilled employee in the milk collecting center. However, farmers are happy to hear, more customized advice and training from development officers at their farm.

*4.4.2.3 Financial support (FS)*

As shown in Figure 4.2, all milk processors provide financial support to the farmers. It was also found that providing financial support can be very context specific. Each farmer was found to have a set of certain financial needs (money or equipment) that milk processors needed to consider. While the amount of monetary loan or grant varied with the request, providing animal feed on a credit basis was found to be the most widely used. Apart from that, equipment such as milk drawing machines, mini refrigerators, milk cans, and grass-cutting machines were also provided on a credit basis by the milk processor. One interesting finding was that one milk processor was advantaged as it had its own bank. Hence this milk processor was in a better position to assess their farmers' repayment capability and adjust the terms and conditions of financial assistance more objectively when providing loans. Apart from that, the same milk processor was able to streamline its milk payments because all the farmers had their own bank account (in the processor's bank). This was well apparent in a farmer's response that *"my* *company provides animal feed on credit basis and deduct the amount from my payments…., and I was recommended by milk collecting center to obtain a loan from their own bank to expand my business and I am so happy".*

The in-depth analysis of the responses of milk processors and farmers revealed that these responses match what is found in the literature (e.g., Brix-Asala et al., 2021; Chopde et al., 2019; Mukucha & Chari, 2021). It was decided that suitable indicators of farmer development in the form of 'financial support' for quantitative research on dairy farmer development in Sri Lanka should include financial assistance, provision of materials and support services, and monetary rewards, at a minimum. It should be noted that literature from different countries identifies financial support in different forms. For example, Brix-Asala et al. (2021) considered financial support only in monetary terms, but through their fieldwork, 'providing material and support' emerged as another farmer development initiative that could be accommodated under financial support. Accepting the fact that different farmers have different needs poses some challenges, the authors of this study suggest that when financial assistance is modeled in quantitative research it may be considered as formative (reflective versus formative construct debate is beyond the scope of this paper) rather as a reflective construct. (for details see Diamantopoulos et al., 2008).

*4.4.2.4 E*valuation and feedback to improve farmer quality performance (EFFQP)

Evaluation and feedback to improve farmer quality performance emerged as a farmer development initiative. Participants provided useful insights. One milk processor stated *"If we receive milk below our quality requirements, we traverse downstream of our SC to identify the source, which could be the farmer, the chilling center for not checking inbound logistics, or the transporting process. Yes, we admit that sometimes traceability is difficult because in certain cases the milk supplied by more than one farmer is poured into a can to make lorry transportation efficient because transporting nearly empty and half-full cans is costly".* The literature (De Silva et al., 2023; Ladele & Kuponiyi, 2006; Pedroso et al., 2021; Yawar & Seuring, 2020) does support the farmers' and processors' responses on evaluation and feedback in general, but it is noted that evaluation and feedback in the Sri Lankan context (judging by the responses received) is only on the quality dimension 'conformance to specifications', which is only one aspect of quality (Swanson, 1997). While meeting customer specifications (in the present study, the customer is the milk processor) is an important aspect of customer value creation (another aspect of quality) there are many other ways customer value can be created by a supplier (Grigg, 2021).

Notably, quality evaluations are predominantly initiated by milk processors rather than an island-wide quality monitoring body to standardize the milk quality assurance process. Consequently, other farmer development issues concerning quality such as auditing (Brix-Asala et al., 2021; Yawar & Seuring, 2020), buyer's personnel working more actively in the supplier's facility on specific tasks (Brix-Asala et al., 2021; Jia et al., 2021), supplier certification (Bai & Satir, 2022; Brix-Asala et al., 2021; Yawar & Kauppi, 2018; Yawar & Seuring, 2020), and letting suppliers compete with each other for larger stakes (Bai & Satir, 2022; Brix-Asala et al., 2021) were found either unsuitable or untenable for the dairy sector in Sri Lanka as such strategies could affect production efficiency. In operations management, a smooth and even flow of goods and information within and outside the production facility is crucial for improving overall operational performance (Schmenner & Swink, 1998). In manufacturing (or services), the term 'smooth' in the phrase 'smooth, even flow' refers to minimal disruptions and bottlenecks, while 'even' refers to minimal variation in the flow of goods and information over time (Schmenner & Swink, 1998). In this context, cherry-picking milk suppliers or conducting audits on the quality systems of every supplier (farm) is beyond the scope of a milk processor who relies on thousands of farmers to supply milk of acceptable quality—not superior quality—to ensure a smooth, even flow of milk, thereby making the processor's production plant as efficient as possible. For the above-mentioned reasons, only sharing information for milk quality improvement, efficient platforms for farmer communication, and prompt feedback on quality issues were identified as the relevant indicators.

## 4.5 Conclusion

The formal milk VC of Sri Lanka was mapped, highlighting the key actors, the important role played by milk processors, and identifying the processor-led farmer development initiatives implemented. Mapping the VC revealed a network of interactions involving farmers, milk collection centers, milk processors, and distribution agents highlighting the key role of milk processors. Based on the responses from key informants, undoubtedly processor-led farmer development takes place in Sri Lanka. It was found that farmer development activities for the study context can be classified under three broad categories (training, financial support, evaluation, and feedback to improve farmer quality performance).

There was no strong evidence to suggest that all processors target farmers with the greatest development potential—those who are most profitable to the processor—but there were indications this might change soon. If processors target farmers with the greatest development potential, they cannot be criticized because, in business, there is no such thing as a 'free lunch' (Friedman, 1975). This shows the room for other actors and stakeholders, including government, policymakers, and NGOs to take initiatives to develop smallholder farmers as in similar countries.

The study acknowledges its limitations. It is important to note that this study uses supplier development as the theoretical lens to explain farmer development. Supplier development is an operations management concept. Scientists in other disciplines can approach farmer development from their perspectives. For example, an animal scientist or an agriculture scientist might focus on animal nutrition and health, while a sociologist might focus on the policy framework. Future research may focus on testing the underlying theory upon which this study was designed using large sample data (hypothesis testing) and conducting longitudinal studies to assess the sustainability of farmer development initiatives in the face of changing social, political, economic, and technological environments in the country.

**The supplementary document to Chapter 4**

This supplementary document has two sections. Section 1 discusses the constructs of the theoretical model (See Figure 5.1 in the Chapter 5), except for the three constructs on farmer development, which are covered in the main body of this chapter (the manuscript submitted to the Journal of Agricultural Sciences – Sri Lanka). Section II reconciles the indicators identified in the literature and against the fieldwork to show indicators that are common to both the literature and the fieldwork. Venn diagrams are presented for ease of understanding.

**Section 1: Insights on Theoretical Model Constructs from Key Informant Interviews**

The fieldwork was designed to explore all the constructs of the researcher's theory, which explains how farmer development initiatives implemented by the milk processor contribute to sustainable farmer performance. The manuscript submitted to the Journal of Agricultural Sciences – Sri Lanka focused solely on insights related to farmer development initiatives. This section examines the remaining constructs of the theoretical model.

**(a) Sustainable farmer performance**

In response to sustainable farmer performance questions in farmer interview guide and milk processor interview guide (See Appendix B and Appendix C), the % of agreement (corroboration) by each group for different indicators of farmer performance is shown in Figure S.1.

Regarding social performance, both milk processors and farmers agreed on three important aspects of farmer social performance. Farmers expressed satisfaction with the quality of life that resulted from dairy farming, the positive impact on their lives, such as being able to provide better education for the children and achieving social recognition (by interacting with fellow farmers and sharing resources) are important. Quality of life was mentioned as an important aspect of social sustainability by all the farmers and milk processors. Some farmers lamented the downward trending of quality of life and social recognition due to economic hardships in the country (in early 2022 during the post-pandemic era).

*"Earlier there was good recognition from society so I was satisfied but now after Covid, due to hardships in running my businesses the recognition I received from the community as an important person declined; Which reduced income at my disposal, I am worried that I will*

*not be able to educate my children well as I am not able to save enough to pay fees for private tuition  my children need to pass the exams".*

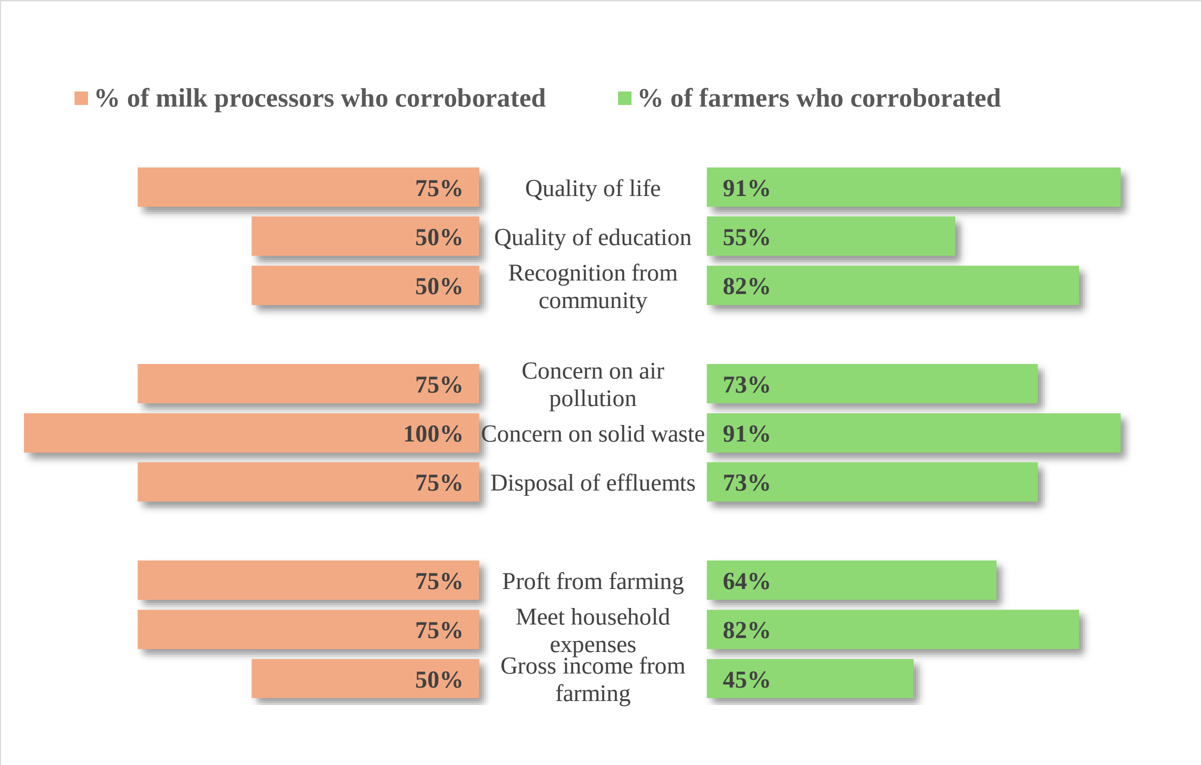



**Figure S.1 The butterfly chart showing the agreement rates on different indicators of sustainable farmer performance**
*(Source: Own work)*

Regarding environmental performance, concerns of both the farmers and processors seemed to be focused on waste management: managing solid waste to minimize negative environmental impact. While awareness of air pollution mitigation actions was limited among farmers, the processors were concerned about it. Interestingly, one milk processor mentioned that they are the first company in dairy industry in Sri Lanka to complete carbon footprint verification, they are further working towards reducing greenhouse gas emission, and they are taking the next step to the chilling center level (solar power, biogas generation) and thereafter to develop the farmers to achieve the same goal (i.e. a zero-carbon footprint). The dual benefits of using cow dung—as both a fertilizer for the farmer's other farming activities and as an income generator through its sale—was found to be widely practiced. One farmer said:

*"We are selling cow dung as compost fertilizer for businesses, other fellow farmers who are involved in vegetable cultivation, etc., and the remainder… we use for our home gardening".*

Farmer environmental performance in the study context is defined by environmentally friendly farming practices that reduce harm to the environment. The use of solid waste for agriculture activities, proper disposal of effluents, and action to reduce air pollution by regular clearing of the cattle shed, composting manure and using covered storage facilities were mentioned by the farmers.

Regarding economic sustainability, farmers highlighted the net income received from dairy farming. Some said that they receive an income that is approximately 100% higher than their expenses; almost all the farmers who said so were found to be practicing extensive farming. This profitability is often attributed to reduced animal feed costs and the dual purpose of animals for both dairy farming and utilizing manure in growing other crops. Farmer satisfaction in their business was evident in statements such as *"satisfied with my business"*, and "*satisfied with the time and money I spent on farming"*, However, one farmer highlighted that his economic outcomes are highly variable, *"there are some good months and some really bad months".* Some farmers mentioned that they also pursue gross income earning through dairy farming because they sell other produce to the processor, thus diversifying their risk (the particular milk processor has a thriving business in the fruit and vegetable market share in Sri Lanka).

In summing up, the fieldwork supported the sustainable farmer performance: economic, social and environmental aspects as being relevant as being mentioned in the literature (De Silva et al., 2023; Lebaq et al., 2013; Zanin et al., 2020).

**(b) Farmer capability (FC)**

All milk processors emphasized that farmer training activities should be geared towards improving farm process management skills and capabilities by way of providing knowledge and skills for the farmers to enable them to improve their capability. Views about farmer capability were not obtained from the farmers as it is unlikely that farmers would be able to articulate different capability bases that their processors is trying to improve.

In response to the question, "What are the important capability areas that you aim to develop through farmer development activities or programs?" (Question B2 shown in Appendix B), the processors provided reasonably convergent responses. The coding of responses highlighted that maintaining good working relations with farm extension service officers was a key aspect of relational capability. Similarly, implementing the knowledge gained from training programs was identified as a driver for improving farm process management capability. The interviews also revealed that the processors' view farmer's quality performance (being able to meet milk quality specifications to reduce the risk of milk rejection due to poor quality) and delivery performance (year-round milk supply in agreed quantities) as key manifestations of farmer capability. One processor said: "*We expect a capable farmer to maintain good working relationships with the stakeholders, including our company,"* and "*be able to improve their performance to consistently supply us milk year-round, in good quality*." Another processor said: "*we expect farmers to adopt modern farm management practices and transition from traditional to modern farming methods*" However it was not supported by the answers of other milk processors and hence will not be considered as manifestations of farmer capability. Overall, the findings identified four aspects of farmer capability improvement: relational capability, quality performance, delivery performance, and farm process management capability. Of the four, two—quality performance and delivery performance—were found to be mandatory elements of supplier performance as identified in supplier development literature. In summing up, the fieldwork supported the literature (e.g De Silva et al., 2023; Nath et al., 2010; Sachitra & Chong., 2018).

**(c) Processor-farmer relationship (PFR)**

All farmers emphasized the importance of commitment in maintaining relationships with their milk processors. For instance, one farmer stated: "*I try to maintain a good relationship with my milk processor"*; another farmer proudly mentioned: *"I have supplied milk to this company for 30 years and plan to continue in doing that for the foreseeable future because my milk processor treats me as an important person and reciprocates with tangible outcomes for me."* Interestingly, another farmer expressed a desire for even closer ties with the company, suggesting proactive engagement. Similarly, another farmer affirmed: *"even if another milk collector offers higher prices, we will continue with my existing milk processor, as I get what I expect from them"*. In supporting this answer another farmer went on to say that *"milk collectors are opportunistic and, my wife and I have no guarantee that what the processor's collector pledges today will be the same tomorrow."*. Interestingly one farmer indicated that he plans to continue dairy farming with improvements suggested by the processor. In this context, commitment is defined as farmers' willingness to sustain long-term relationships with milk processors and make short-term adjustments to maintain these relationships. The fieldwork corroborated three indicators of 'commitment' found in the literature—expectation of continuity, identification, and willingness to invest—being relevant to the Sri Lankan dairy industry.

Additionally, satisfaction with milk processors emerged as another critical manifestation of the processor-farmer relationship. Farmers cited various reasons as to why satisfaction is important to them. Some examples include receiving a competitive price for the milk being delivered, additional financial benefits compared to other companies, and friendly interaction with the milk processor’s milk collection center staff. Notably, one farmer highlighted the company's meticulous record-keeping and transparent transactional practices, which contribute to farmer satisfaction. Milk processors, on their part, do seem to make an effort to enhance satisfaction; for example, one processor mentioned developing software for better farmer communication. Satisfaction as applied to the study context can be identified as ‘the overall perception on the price, milk-processor, and the communication between dairy farmers and milk processors.’

Trust emerged as the third sub-dimension (manifestation) of the processor-farmer relationship. Farmers expressed trust in the support and services the milk processor provides, while some noted prompt financial assistance when needed as a trust aspect. It was found that this trust has generally been reciprocated by the milk processors, as evidenced by statements of milk processors. Factors such as honesty, benevolence, trust in competence, and integrity were found to be contributing towards ‘trust’ as perceived by the farmers. Integrity was also to be an indicator of trust in the context of a processor-farmer relationship in the Sri Lankan context, implying reliability and ethical conduct expected from the milk processors.

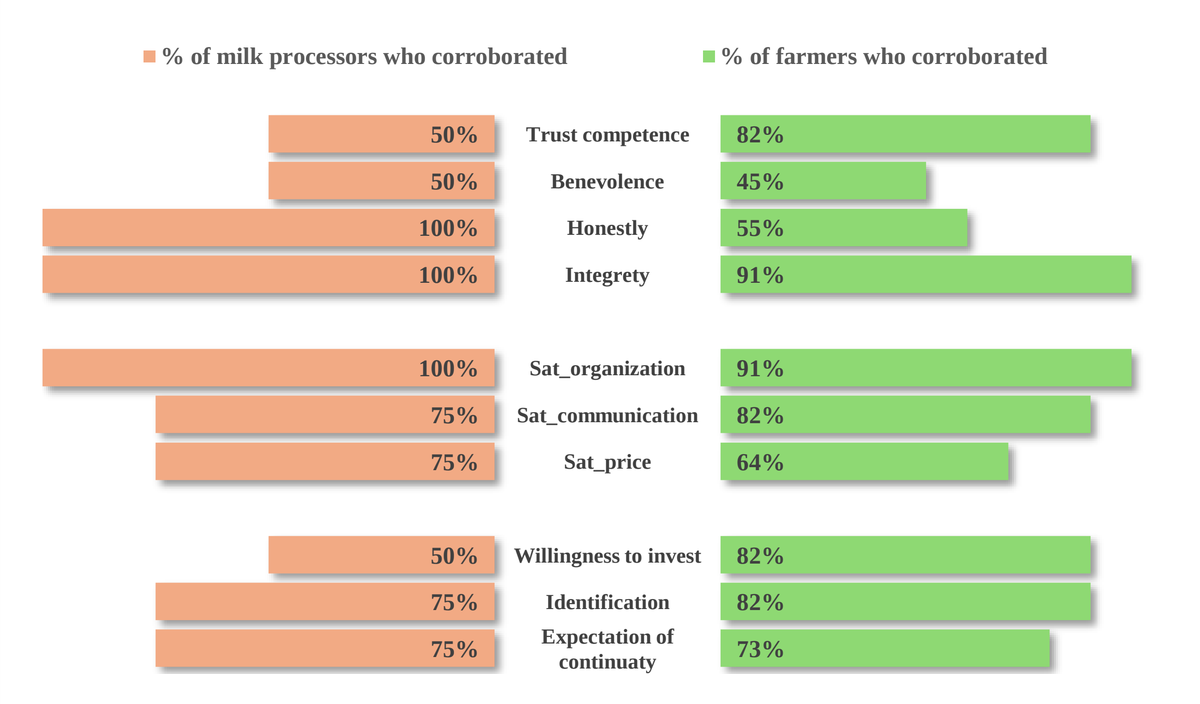



**Figure S.2 The butterfly chart showing the agreement rates on different indicators of the 'processor-farmer relationship'**
*(Source: Own work)*

In summing up, the fieldwork supported the three facets of the 'processor-farmer relationship' as being relevant as being mentioned in the literature (De Silva et al., 2023; Lees et al, 2020; Moses et al., 2023).

**Section II: Final decision on the operationalization of constructs based on the literature and insights from key informant interviews**

The Venn diagrams shown in the next four pages depict how the literature was reconciled against the insights from fieldwork to finalize the indicators that should be included in the operationalization of the constructs, for the purpose of theory testing (See Figure 5.2 in the next chapter).

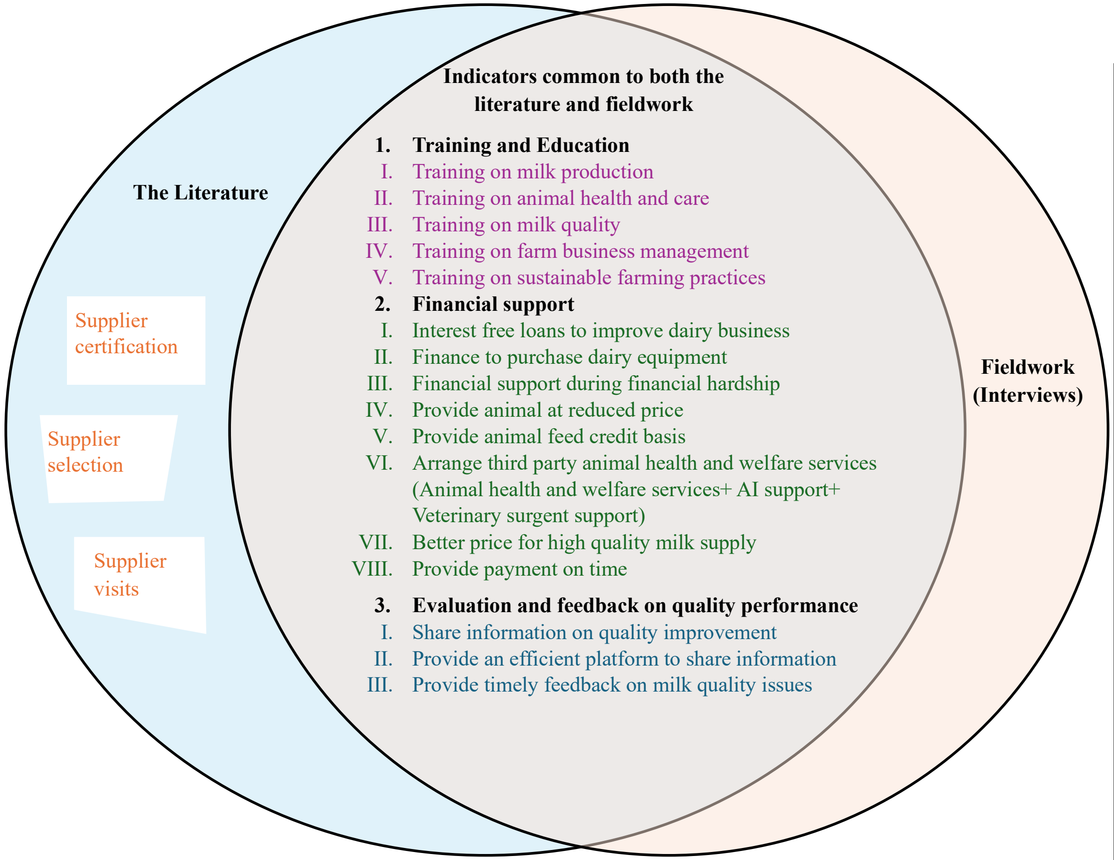
## The Literature

- Training
- Education
- Provide advice/ onsite consultation
- Transfer of implicit knowledge

- Financial/ capital /resources
- Setting improvement targets
- Supplier rewards
- Proving material and services

- Supplier evaluation and feedback
- Supplier monitoring

- Supplier certification
- Supplier selection
- supplier visits




## Fieldwork (Interviews)
**11 Farmers (F) and 4 Processors (P)**

| Indicator | F | P |
|---|---|---|
| - Training on milk production/ collection | 9 | 4 |
| - Training on animal health | 10 | 4 |
| - Advice on milk hygiene/milk quality | 10 | 4 |
| - Training programs on farmer business management | 6 | 3 |
| - Training and advice on sustainable farming | 2 | 2 |
| | 10 | 3 |
| - Interest free loan facilities to improve farm business | | |
| - Finance to purchase dairy equipment | 7 | 2 |
| - Financial assistance during hardship | 8 | 4 |
| - Provide animal feed on reduce price | 7 | 4 |
| - Animal nutrition/feed to payment on credit basis | 11 | 4 |
| - Animal health & welfare through third party | 7 | 2 |
| - AI support through third party | 5 | 3 |
| - Veterinary surgent support | 6 | 2 |
| - Better price for high quality milk | 7 | 3 |
| - On time payment | 10 | 4 |
| - Share information on continuous quality monitoring | 11 | 4 |
| - Efficient platform to share information with the processor | 8 | 4 |
| - Evaluation & feedback on quality issues | 6 | 3 |

**Figure S.3 'Farmer development' indicator selection Venn diagram (the literature Vs fieldwork)**

*(Source: Own work)*

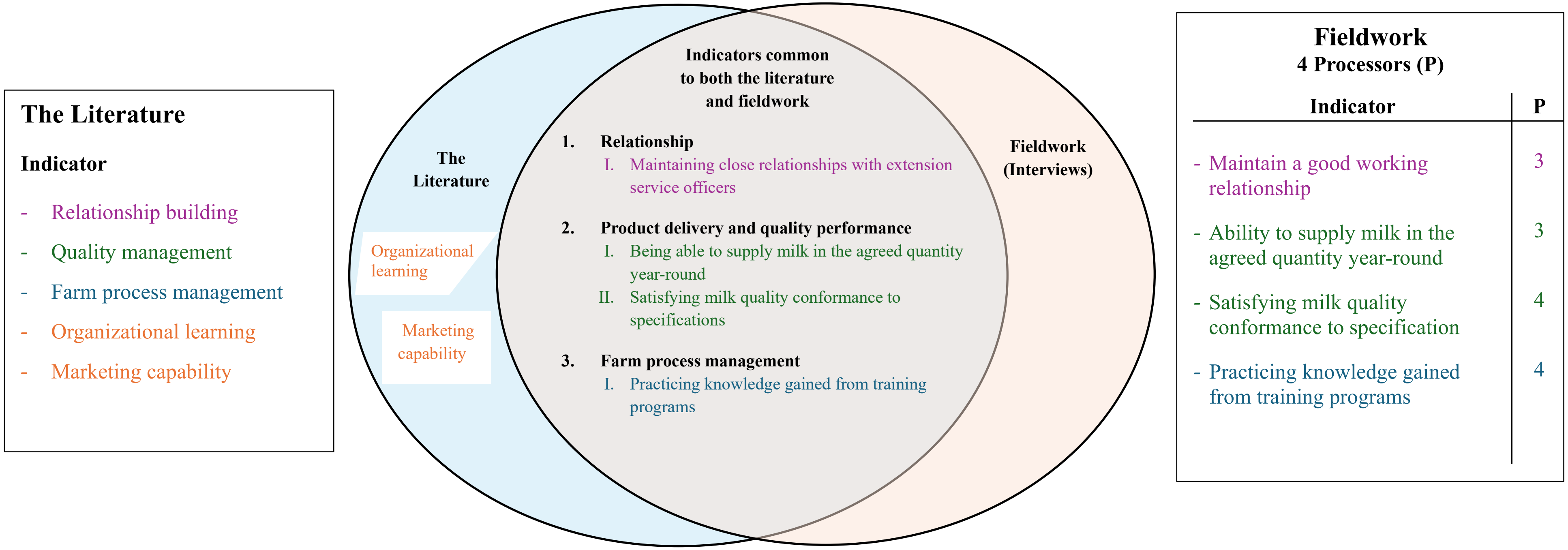


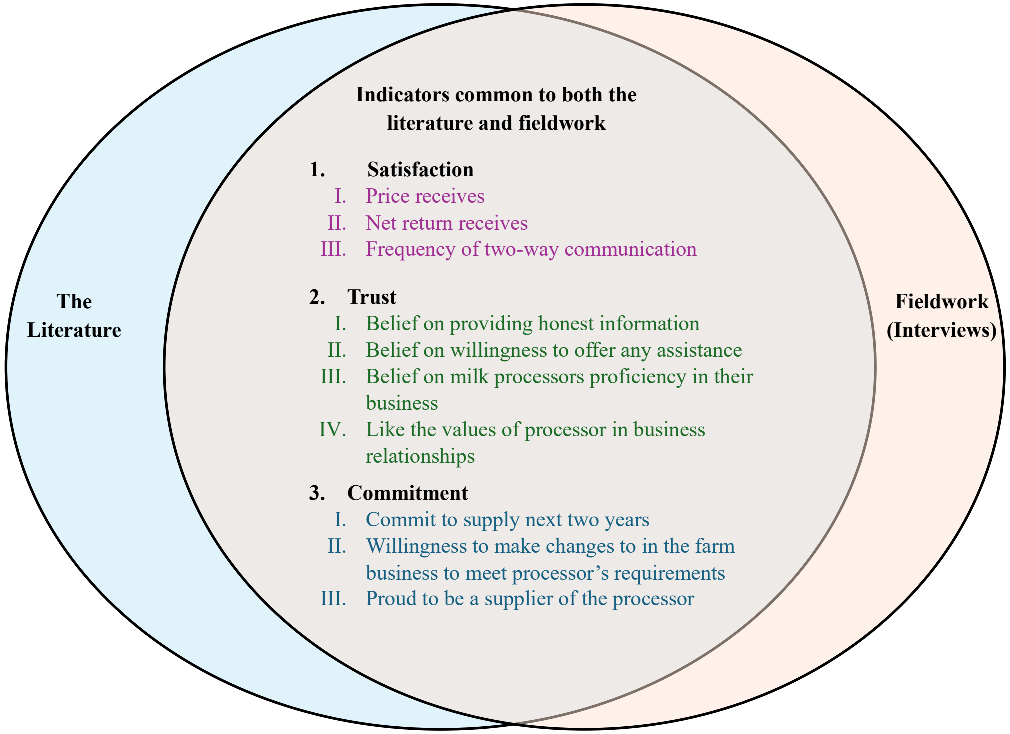

**Figure S.4 'Farmer capability' indicator selection Venn diagram (the literature Vs fieldwork)**
*(Source: Own work)*

## The Literature

**Satisfaction**
- Satisfaction with price
- Satisfaction with communication
- Satisfaction with organization

**Trust**
- Honesty
- Benevolence
- Competence
- *Integrity*

**Commitment**
- Expectation of continuity
- Identification
- Willingness to invest




## Fieldwork (Interviews)
**11 Farmers (F) and 4 Processors (P)**

| Indicator | F | P |
|---|---|---|
| - Satisfied with price receive | 8 | 3 |
| - Satisfied with the net return received by suppling milk to the processor | 9 | 3 |
| - Satisfied with the two-way communication | 10 | 3 |
| - Provide honest information (reliability on payment, and maintain records) | 11 | 3 |
| - Willingness to offer assistance (Assistance from the milk processor) | 8 | 4 |
| - Milk processor is proficient in their business | 6 | 3 |
| | 7 | 3 |
| - Like the values of processor in business relationships (good perception about the processor) | | |
| - Commit to supply during next two years (Willingness for future transactions) | 10 | 4 |
| - Willing to make changes to meet processor requirements (Not switching the network) | 10 | 2 |
| - Proud be a supplier to the processor | 10 | 2 |

**Figure S.5 'Processor-farmer relationship' indicator selection Venn diagram (the literature Vs fieldwork)**
*(Source: Own work)*

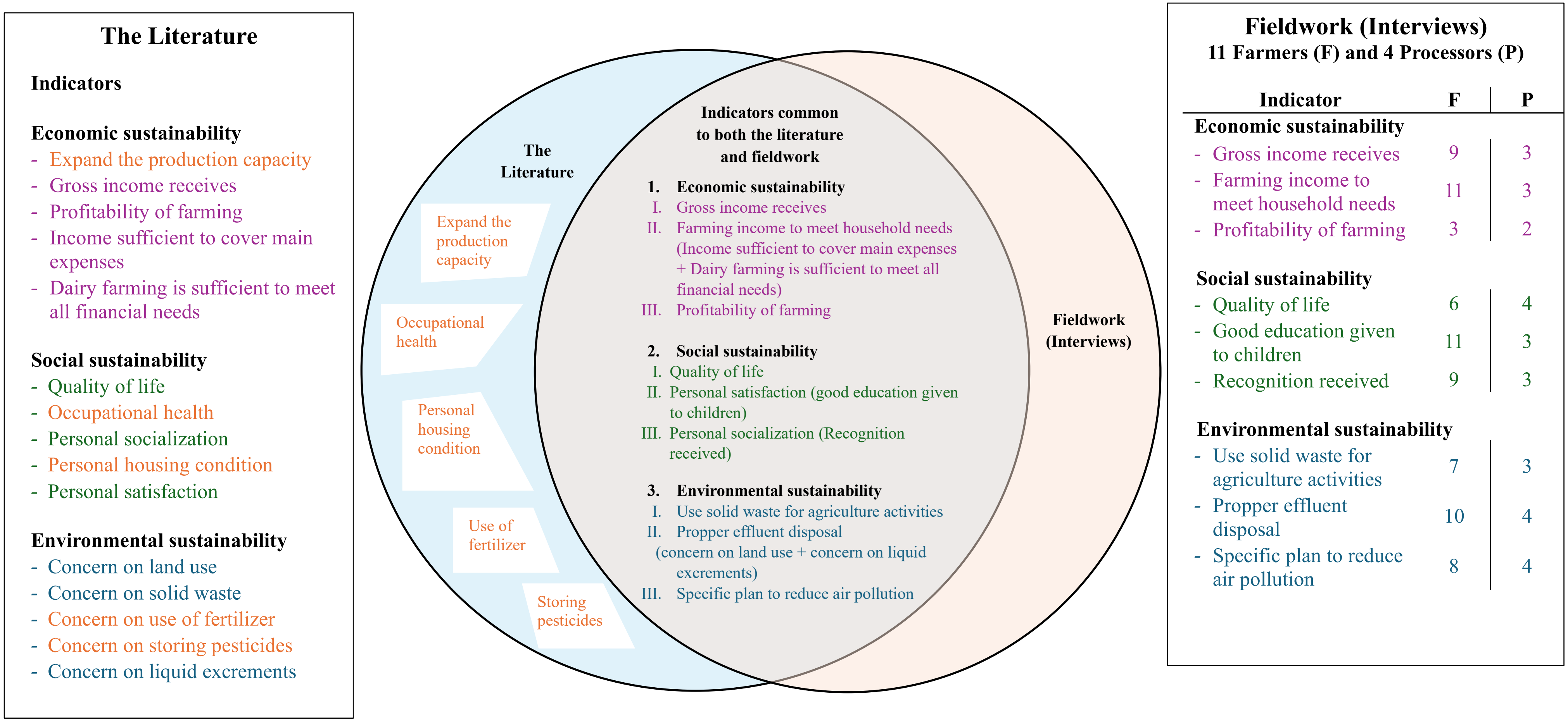



**Figure S.6 'Sustainable farmer performance (economic, social, and environmental)' indicator selection Venn diagram (the literature Vs fieldwork)**

*(Source: Own work)*

# CHAPTER 5:
# SUPPLIER DEVELOPMENT TO IMPROVE SUPPLIER SUSTAINABLE PERFORMANCE: A TEST ON A DAIRY SUPPLY CHAIN OF A DEVELOPING COUNTRY

This chapter has been submitted as a manuscript to the journal: International Journal of Productivity and Performance Management. The manuscript is in the second round of its review process. The International Journal of Productivity and Performance Management (Publisher: Emerald, UK) is a double anonymous peer-reviewed journal. The journal website states that the journal has "high-quality content covering all aspects of productivity and performance management"[19]. The journal is classified as a Q1 journal (in business, management, and accounting (miscellaneous) with an impact factor of 3.6 in 2023, and is indexed by Scopus and Clarivate. Some parts of this chapter were presented as an extended abstract at the Australasian Agricultural Resource Economies Society (AARES) conference held in Canberra, Australia from 7th –10th February 2024. To present this study, the research was also awarded two grants—the Australian Centre for International Agricultural Research (ACIAR) travel grant, and the Massey University Doctoral Conference Grant—which is acknowledged.

This chapter refines the initial theoretical model presented in Chapter 3 to elevate it to become a testable theoretical model. The chapter covers full details of model development, data collection (the data pertains to responses from 324 Sri Lankan dairy farmers covering Nuwara Eliya and Kurunegala districts), data analysis covering hypothesis test results, and interpretation of the findings from, theory, practice, and policy perspectives. The significance level of 0.05 (Type I error) was taken in judging the statistical significance (i.e. a parameter returning a $p$<0.05 was considered significant and a parameter returning a $p$>0.05 was considered nonsignificant).

The manuscript submitted to the journal (International Journal of Productivity and Performance Management) does not show power analysis results to justify the adequacy of a sample size of 324. The minimum sample size requirement was calculated, *a priori*, using two methods: the method prescribed by Cohen (1992), which is highly cited; and, the "inverse square root

[19] International Journal of Productivity and Performance Management. (n.d.). Retrieved 02 January 2025 from https://www.emeraldgrouppublishing.com/journal/ijppm

method" prescribed by Hair et al. (2022); Hair et al. are experts on PLS-SEM statistical modeling—the approach used in this chapter.

Cohen's method (Cohen, 1992) is based on the F statistic of the particular regression model under scrutiny, and hence the number of predictors included in the regression model becomes relevant in determining the sample size required to achieve the 0.80 power (80% power); this sample size is the minimum sample size (Cohen, 1992). In the researcher's statistical model (See Figure 5.2), the most complex regression equation (the one that contains the greatest number of predictors) is the equation that predicts the score of Financial Support (FS), which has 8 predictors (FS1 to FS 8). The minimum sample size to return a significant model, based on Cohen's prescription is 107 cases (Cohen, 1992, p. 158), under standard assumptions of: statistical power =0.80, significance level =005, and $f^2 = 0.15$.

The more conservative method prescribed by Hair et al. (2022, p. 16) returned a minimum sample size of 275, based on the equation shown below:

$$\text{Minimum sample size under 0.05 significance level and 0.80 power} = \left(\frac{2.486^2}{\rho_{min}}\right)$$

Where $\rho_{min}$ is the minimum standardized regression coefficient one is interested in (Hair et al., 2022, p. 16). Although Hair et al. suggest 0.20 as a minimum (practically meaningful) standardized regression coefficient, which would have returned a minimum sample size of 155 cases, the researcher considered 0.15 as the minimum (practically meaningful) standardized regression coefficient that she would be interested in, thus returning a minimum sample size of 275 cases, which is much lower than the 324 cases that the researcher used in her modeling.

**References**

Cohen, J. (1992). A power primer. *Psychological Bulletin 112*(1), 155-159.

Hair Jr, J. F., Hult, G. T. M., Ringle, C. M. & Sarstedt, M. (2022). *A primer on partial least squares structural equation modeling (PLS-SEM),* Sage.

**Abstract**

**Purpose** – The paper develops and tests a theoretical model that explains how different types of sustainable supplier development (SSD) initiatives implemented by an agrifood processor improve the sustainable performance of the supplier, in a developing country.

**Design/methodology/approach** – The theoretical model was tested in a dairy farming context in Sri Lanka where a substantial number of smallholder farmers supply milk to their processors. The authors theorized SSD in the form of farmer training, financial support, and 'evaluation and feedback on farmer's quality performance' initiated by the milk processor improves the economic, social, and environmental performance of the farmers through the mediating roles being played by farmer capability and the processor-farmer relationship. The data were collected from 324 dairy farmers and the theoretical model was tested using Partial least squares structural equation modeling (PLS-SEM).

**Findings** – The mediating effect through the processor-farmer relationship was significantly greater than that through farmer capability. The findings highlighted the pivotal role of the processor-farmer relationship in mediating the link between SSD initiatives and sustainable farmer performance while downplaying the significance of farmer capability as a mediator. Among the three SSD initiatives, financial support had the greatest impact on sustainable farmer performance, while farmer training had the least impact; training had an impact in the region where exotic cows were raised.

**Originality** – The study demonstrated how supplier development theory in operations management applies in an agri-food context of a developing country.

**Keywords** Sustainable supplier development, Sustainable performance, Farmers, Developing countries

**Paper type** Research paper

## 5.1 Introduction

As good corporate citizens and to gain competitive advantage, manufacturers focus on improving productivity and performance across their supply chain (SC) (Carter & Rogers, 2008; D'Agostini et al., 2017; Kumar & Goswami, 2019). Within the realm of operations management and supply chain management (SCM), it has been cogently argued that a manufacturing firm can gain a competitive advantage over its competitors by developing the capability of its core suppliers—a concept known as supplier development (SD) (Krause et al., 2007; Wagner, 2009). Strong and collaborative buyer-supplier relationships are anticipated to improve performance for both parties under these circumstances (Benton et al., 2020; De Silva et al., 2023; Giraldi et al., 2024). Here, one assumption is that when performing without the buyer's support, many suppliers will not have the capability to generate customer value—the customer being the buyer—required for the SC to function optimally (Krause et al., 2009). Another assumption is that, while SD is initiated by the buyer (manufacturer) for its gain, the recipients (the suppliers) would also benefit by being able to improve their business performance on financial and nonfinancial dimensions, which is known as sustainable performance. Sustainable supplier development (SSD) extends traditional SD by focusing on improving the economic, environmental, and social outcomes of suppliers. SSD encourages manufacturers—as focal companies—to adopt a triple-bottom-line (TBL) approach to supplier performance improvement expectations (Bai & Satir, 2022; Carter & Rogers, 2008; Pedroso et al., 2021; Seuring & Müller, 2008). In this study, 'sustainable performance' refers to a farmer's business performance across the TBL dimensions/metrics. Bai and Satir (2022, p. 1) defined SSD as "any initiative taken by the buying firm to improve their supplier sustainability capabilities to meet two or more elements of the triple bottom line (TBL) of multiple stakeholders along the supply chain (suppliers, buying firms, customers, etc.)."

Despite substantial theory development on SSD recently, what is not known well is how SSD applies to an agri-food SC, particularly in a developing economy. Farmers supply their produce to a processor, who in effect becomes the buyer. Thus, in an agri-food context, SSD translates to processor-led farmer development (abbreviated FD hereafter). Specifically, this study aims to develop a theoretical model and empirically test it to demonstrate how SSD initiatives of a milk processor improve the sustainable performance of dairy farmers in a specific context.

In a non-perishable goods SC, when SSD is chosen as a manufacturing strategy, such as in lean manufacturing, supplier selection plays a crucial strategic role. This is because the buying firm can select the optimal supplier (or few suppliers) for purchasing a given component or raw material, by considering multiple criteria such as quality of goods supplied, product reliability, delivery reliability, and carbon footprint (Krause *et al.*, 2007, Benton et al., 2020). Under these circumstances, the selected suppliers of strategic importance would receive more direct support from the buyer (Wagner, 2009, Krause *et al*., 2007); such situations result in maintaining a strong, mutually reinforcing collaborative relationship between the two parties to ensure an uninterrupted supply of high-quality goods and services (Benton et al., 2020, Krause et al., 2007). In contrast, a perishable goods SC such as an agri-food SC poses unique challenges including perishability of the commodities, high waste, quality variability, seasonality, and susceptibility to natural events (Joshi et al., 2023; Susanty et al., 2019). These challenges are amplified in developing economies with fragmented SCs, limited resources, poor infrastructure, and inadequate support, disproportionately affecting smallholder farmers– the majority of the agri-food SC (Jayasena et al., 2020; Kilelu et al., 2017; Tricarico et al., 2020; Trienekens, 2011; Yawar & Seuring, 2020).

Among many agents who can be involved in improving the performance of smallholder farmers in a developing economy, when the involvement of other agencies is minimal, privately-owned processors as the focal companies, have a strong incentive to develop their farmers for mutual benefits (Joshi et al., 2023; Yawar & Seuring, 2018). This situation stands partially analogous to SSD in non-perishable goods SC, the major difference being the presence of potentially thousands of suppliers (mostly smallholder farmers) of the same commodity. Given the aim of the study, its *central proposition* is: "In situations where there are minimal SSD initiatives from other agents, SSD initiatives undertaken by a privately-owned processor can result in improved sustainable performance of farmers in a developing country." In the study context, FD and SSD overlap significantly, as theoretical concepts. A dairy SC of a developing country was specifically chosen as the context to develop and test the theoretical model because dairy SCs in developing countries have received great attention due to issues such as food self-sufficiency, population increase, economic growth, and the resulting high demand (Bhat et al., 2022; Damunupola et al., 2022; Naganboyina & Kaple, 2022; Susanty et al., 2018).

The first question that needs an answer before developing and testing a theoretical model that underpins the above central proposition is: what factors affect dairy farmer capability in a developing country agri-food SC? For the dairy SC under consideration, these have been the lack of high-quality inputs (especially silage) for cows, poor dairy management practices, inadequate extension services, and a reluctance to enforce a national milk quality standard (Vyas et al., 2020). The second question that needs an answer is: what is the theoretical relationship between FD initiatives and sustainable performance of farmers, under a scenario of SSD? If SSD takes place, given the definition of SSD, when SSD is increased, at two TBL outcomes of the farmers must increase. However, the scope of a business can constrains what a business can achieve in each TBL dimension (Bai & Satir, 2022; Carter et al., 2020). Although the literature supports the notion that a milk processor's efforts to develop their farmers through training, financial support, evaluation and feedback on quality performance improves the socioeconomic status of the farmers (Mariammal et al., 2018; Thakur et al., 2022; Yawar & Seuring, 2018), what is unclear is the link between FD initiatives (cause) and the TBL performance of the farmers (effect). The present study introduces farmer capability (FC) and the processor-farmer relationship (PFR) as mediators (intervenors) that mediate/intervene in the relationship between FD initiatives and the TBL performance of the farmers.

The remainder of this paper is structured as follows: section 5.2 reviews the theoretical background that leads to hypothesis development. Section 5.3 presents the methodology. Section 5.4 covers the results. Section 5.5 discusses the findings. Finally, section 5.6 concludes the study, outlining key implications, study limitations, and suggestions for further research.

## 5.2 Theoretical background and hypothesis development

The development of the SD concept has progressed through three stages: During the initial stage, the focus of SD was on providing direct assistance to suppliers—sometimes known as direct SD—to improve the quality of goods being supplied through supplier performance improvement. Leenders (1966) was a key figure during that era. During the intermediate stage, which coincided with the quality movement (1980–2000) driven by principles advocated by quality pioneers such as Deming, the focus shifted toward fostering long-term buyer-supplier relationships, while retaining the core characteristics of direct SD. The work of Krause et al. (2007) and Wagner (2006) were significant during this period. In the third stage (2000 onwards), the focus shifted towards SSD due to parallel theory development on SSCM by key authors such as Seuring and Müller (2008); Carter and Rogers (2008). Aligning the TBL farmwork (introduced by Elkington, 1994) with SSCM as a tool for measuring a supplier’s sustainability was a significant development during the era through the works of Pagell and Wu (2009), Pedroso et al. (2021), and others. In addition, the works of Yawar and Kauppi

(2018), Yawar and Seuring (2018) were particularly important, as these studies focused on SSD in the agri-food sector of developing economies.

As a profit-optimizing firm, looking through an instrumental stakeholder theory lens (Donaldson & Preston, 1995), the processor needs to sustain an optimum level of SSD and relationships—not too much and not too little—with individual farmers, whose developmental needs may vary (Benton et al., 2020; Yawar & Seuring, 2018). Further, the theory of swift and even flow in operations management argues that allowing material and information to flow fast with minimal variability makes processes efficient and effective, for which the suppliers' performance is critical (Schmenner & Swink, 1998). From an agri-food produce perspective, this means the delivery of high-quality produce by the processor in the right quantity at the right time with minimal variability. Thus, both the above theories justify why a processor of agri-food produce may develop their farmers and maintain good relationships with them.

Based on the literature, this study considers three categories of FD initiatives: farmer training (FT)–providing training and education to dairy farmers to improve their farming skills; financial support (FS)–a board category which refers to providing equipment, production input material (e.g. animal feed), affordable loans, a favorable and expeditious payment system for the produce; evaluation and feedback on farmer's quality performance (EFFQP)–providing continuous evaluation and feedback on the quality of milk being supplied by the farmer (Aniagyei et al., 2024; Brix-Asala et al., 2021; Chopde et al., 2019; De Silva et al., 2023; Ladele & Kuponiyi, 2006; Mukucha & Chari, 2021; Thakur et al., 2022; Yawar & Seuring, 2018).

For this study, sustainable farmer performance is defined as the overall farmer performance captured through TBL dimensions. From a statistical perspective, all three TBL dimensions are accounting variables—each variable being a collection of measurement items that collectively form the variable—rather than constructs that possess psychometric properties. In the study context, economic sustainability (ES) is a collection of financial measures relevant to the farm business, social sustainability (SS) is a collection of social measures (e.g., the quality of life of the family, access to education for the children, and community recognition through interactive farming activities involving the sharing of resources with fellow farmers), and environmental sustainability (EnvS) is a collection of environmentally sustainable farming practices (De Silva et al., 2023; Lebacq et al., 2013; Zanin et al., 2020). The study assumes that the more intense the environmentally sustainable farming practices, the more the farm business becomes environmentally sustainable.

Smaller firms often possess fewer and narrower capability bases than large-scale firms, though this could be industry-specific (Ngugi et al., 2010). Applying this to agri-food, for smallholder and medium-scale farmers in the study context, farmer capability (FC) reflects being able to practice what a farmer learned from formal training, maintaining relationships with extension service providers, delivering milk quantities the processor envisages, and maintaining milk quality specifications (De Silva et al., 2023; Nath et al., 2010; Sachitra & Chong, 2018). Thus, the present study considers the abovementioned four types of farmer capabilities in operationalizing FC. In a dairy SC, the processor obtains its primary production from thousands of farmers to optimize the utilization of their plants to meet the customer demand. In addition, there could be large fluctuations in the quality and quantity of milk being supplied, especially by smallholder farmers in a developing country. However, the processor needs to manage their large smallholder farmer base to ensure its productivity by establishing a steady supply of quality milk. Thus, relational exchanges in this context—as opposed to close relationships with a selected few critical suppliers, such as in lean manufacturing—require collaborative relationships with a large supplier base for optimal performance (De Silva et al., 2023; Giraldi et al., 2024; Pappa et al., 2019). In maintaining collaborative relationships, trust, satisfaction, and commitment can be identified as the relevant indicators of the construct 'buyer-supplier relationship' (De Silva et al., 2023; Lees et al., 2020; Moses et al., 2023). In the present study, the buyer-supplier relationship is labelled as the processor-farmer relationship (PFR).

### 5. 2.1 FT, FS, and EFFQP as determinants of FC

Processor's investment in FT specifically for the buyer's input needs, results in asset specificity, ensuring higher buyer and supplier productivity for that specific situation (Brix-Asala et al., 2021; Mariyono, 2019; Yawar & Seuring, 2018). Farmers who have received relevant training are likely to use more food safety and quality practices to ensure milk quality (De Silva et al., 2023; Kataike et al., 2018; Korale-Gedara et al., 2023) while improving their capacity and productivity (Luther et al., 2018; Mariyono, 2019; Susanty et al., 2019). The above argument led to the following hypothesis:

**H1.** FT has a positive effect on FC.

Processor's involvement in FS benefits the farmer in several ways (Yawar and Seuring, 2018). FS to purchase machinery and equipment leads to improved supplier capability (Chopde et al., 2019; De Silva et al., 2023; Korale-Gedara et al., 2023). Farmers who are financially assisted tend to adopt more food safety practices ensuring the quality of milk (Korale-Gedara et al., 2023). Moreover, industry-specific assistance (e.g., silage for cows and veterinary support) has been shown to benefit dairy farmers by improving their productivity (Brix-Asala et al., 2021). The above argument led to the following hypothesis:

**H2.** FS has a positive effect on FC.

Processor's involvement in performance monitoring is effective in improving supplier capability (Wagner, 2009). Milk processors test the delivered milk at their collection centers for quality; they provide feedback to address quality issues at the farmer level (Brix-Asala et al., 2021; Wouters et al., 2007). While this feedback system allows farmers to maintain a good rapport with their processor, it also creates a platform to identify milk quality deficiencies and upskilling needs to continue supplying milk to the processor, leading to enhanced capabilities derived from the knowledge and skills gained during the training (De Silva et al., 2023, Yawar and Seuring, 2018). The above argument led to the following hypothesis:

**H3.** EFFQP has a positive effect on FC.

### 5.2.2 FT, FS, and EFFQP as determinants of the PFR

Long-term buyer-supplier relationships are necessary for business success of both parties (Benton et al., 2020; Monczka, 2020). When a milk processor invests in FT, farmers become more equipped with essential farming skills and knowledge. This in turn fosters trust and mutual commitment between the processor and their farmers, thus strengthening the PFR (De Silva et al., 2023; Kumar et al., 2023; Shukla et al., 2023; Yawar & Seuring, 2020). The above argument led to the following hypothesis:

**H4.** FT has a positive effect on the PFR.

FS to improve a farmer's business enhances a farmer's trust, commitment, and satisfaction while creating an environment to sustain long-term relationships—on one hand, farmers view their processor as a reliable partner interested in their success, and on the other, it becomes necessary for the processor to continue maintaining the relationship with the farmer to ensure that the investment results in its intended purpose (Benton et al., 2020; Yawar & Seuring, 2018). Additionally, FS can stabilize the milk supply by fostering commitment, as farmers are more likely to maintain a long-term partnership with processors who contribute to their economic resilience (De Silva et al., 2023; Taremwa et al., 2021). The above argument led to the following hypothesis:

**H5.** FS has a positive effect on PFR.

A processor’s feedback on farmer’s milk quality and through sharing of information strengthens the tie between the two parties (Wagner, 2006, Yawar and Seuring, 2020). When a processor actively engages in assessing the quality of a farmer’s outputs (i.e., raw milk) and shares tailored and timely feedback, a farmer can gain insights into how they can meet the required product standards and specifications, keeping the farmer interested in sustaining the PFR (Brix-Asala et al., 2021). This collaborative approach builds trust as farmers see processors as committed partners invested in their continuous improvement and success. Additionally, feedback creates transparency and accountability, aligning farmer performance with processor expectations. This alignment creates farmer satisfaction, trust, and long-term commitment towards their processor (De Silva et al., 2023, Yawar and Seuring, 2018). The above argument led to the following hypothesis:

**H6.** EFFQP has a positive effect on PFR.

### 5.2.3 FC as an additional determinant of the PFR

A more capable supplier will be more knowledgeable about what they need to do to improve their business to meet the processor’s expectations (De Silva et al., 2023). One such expectation is milk quality. Another expectation is a continuous supply of milk to maintain the smooth and even flow envisaged by the processor. While maintaining a closer relationship with the processor enables the farmer to respond to any operational issue (e.g. nonconformity) more swiftly due to faster information flow, the farmer must have the necessary capability to solve the operational issue(s) to satisfy the processor (Sachitra and Chong, 2018). A capable farmer thus positions themselves as a reliable supplier, reinforcing the processor's confidence in the farmer’s capability. Consequently, more capable farmers are likely to engage in more productive and collaborative relationships with their milk processors (Shukla et al., 2023). The above argument led to the following hypothesis:

**H7.** FC has a positive effect on PFR.

The next two hypotheses, each having three sub-hypotheses, are posited to complete the explanation of SSD.

### 5.2.4 FC as a determinant of sustainable farmer performance

The more capable the farmer—meaning a farmer who can practice the knowledge gained from training, maintain close relationships with farm extension service providers, provide year-round milk supply in the required quantity, and meet required quality specifications—the more revenue they could earn over costs (De Silva et al., 2023, Mariyono et al., 2022, Vyas et al., 2020). The above argument led to the following hypothesis:

**H8*a*.** FC has a positive effect on ES.

A more capable farmer is more able to improve net returns on their investment resulting in a higher standard of living (De Silva & Sandika, 2012; Yawar & Seuring, 2017, 2018). In addition, the more capable the farmer, the more recognition the farmer receives from fellow farmers as a valuable person who exchanges resources with them (De Silva et al., 2023; Luther et al., 2018). The above argument led to the following hypothesis:

**H8*b*.** FC has a positive effect on SS.

A farmer who possesses high capability is able to practice environmentally friendly practices, such as proper waste disposal, the ability to find applications for solid waste and ways to reduce air pollution to boost environmental performance (De Silva et al., 2023; Korale-Gedara et al., 2023; Zanin et al., 2020). In a smallholder farmer context, even a simple step such as frequent washing of the cattle shed would reduce air pollution. The above argument led to the following hypothesis:

**H8*c*.** FC has a positive effect on EnvS.

### 5.2.5 PFR as a determinant of sustainable farmer performance

Relationships can lead to relational rents, meaning above normal profits and gain competitive advantage from relational networks both via inimitable resource bundles and relationships (Benton et al., 2020; Lees et al., 2020). Thus, it can be inferred that the processor has an incentive to actively work towards establishing a strong relationship with their farmers; a strong relationship between a processor and the farmer enables a farmer to better identify the processor's requirements and make a consorted effort to meet the processor's expectations, which could result in greater economic outcomes to the farmer (De Silva et al., 2023, Yawar and Seuring, 2020). A stronger PFR may also secure a more long-term purchase contract, greater incentivization for exceeding volume and quality requirements, a better price for milk, reduced income fluctuation, and more help from other parties (e.g. banks, veterinarians) that eventually lead to greater financial outcomes (De Silva et al., 2023; Lees et al., 2020; Werff et al., 2018; Yawar & Seuring, 2020). These arguments lead to the following hypothesis:

**H9*a*.** PFR has a positive effect on ES.

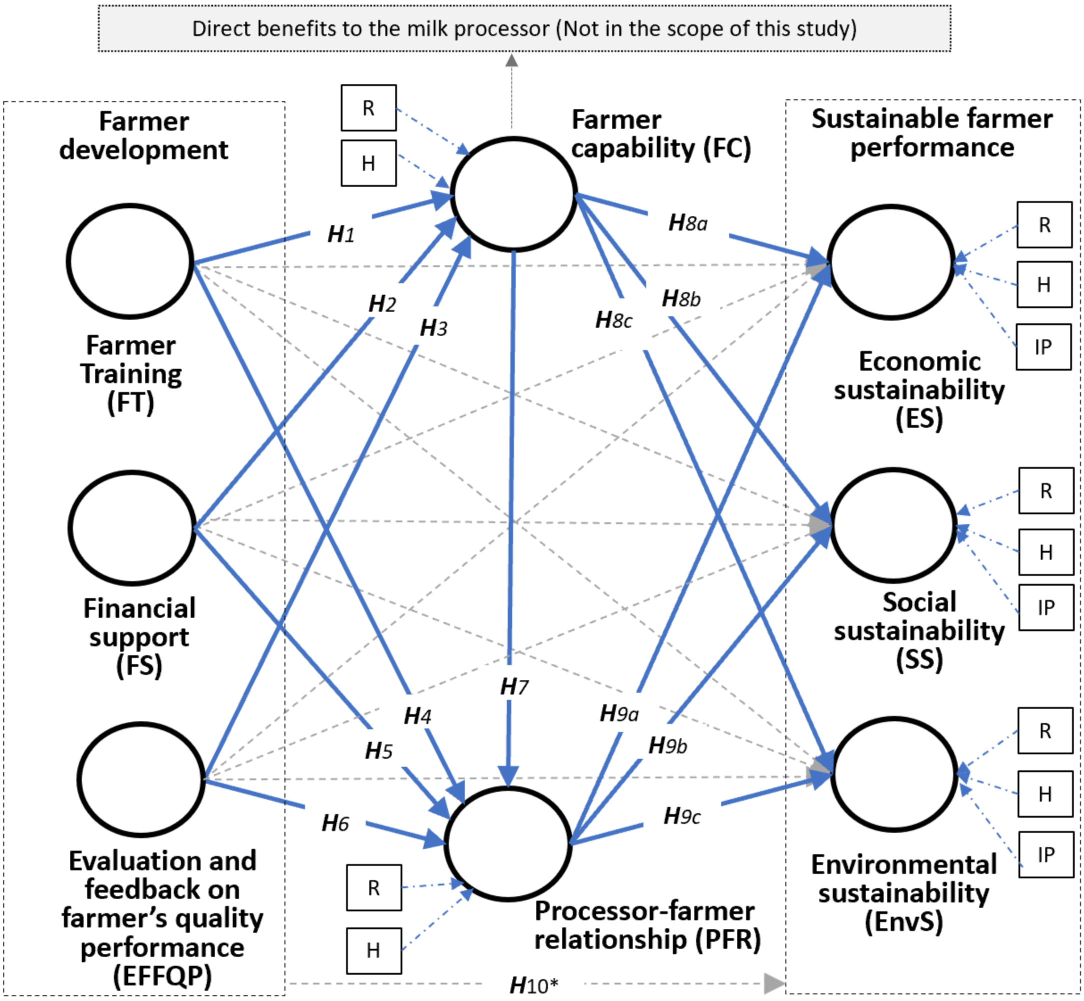
A stronger PFR improves the quality of life of the farmer and their family, receiving more help from the processor to educate the farmer's children (e.g. free schoolbooks and uniforms) and community recognition (Yawar and Seuring, 2018). Moreover, farmers who maintain close relationships with their processor, are more likely to establish third-party collaborations, further strengthening the farmer's social network and status, within the farming community (De Silva et al., 2023, Yawar and Seuring, 2018). These arguments lead to the following hypothesis:

**H9*b*.** PFR has a positive effect on SS.

The PFR contributes to EnvS by facilitating the adoption of environmentally friendly practices and enhancing resource efficiency for the following reasons. A farmer who maintains a strong relationship with their processor is more likely to learn and practice green farming practices as they get more opportunities to learn and reach out for advice (De Silva et al., 2023; Korale-Gedara et al., 2023). This strong PFR not only helps farmers reduce their environmental footprint but may also bolster the processor's CSR campaign, which may reciprocally benefit the engaged farmer. These arguments lead to the following hypothesis:

**H9*c*.** PFR has a positive effect on EnvS.

Hypotheses H1 to H9*c* collectively represent the explanation and prediction of the SSD phenomenon in the study context, which is diagrammatically shown in Figure 5.1 as a theoretical model. Three control variables also appear in Figure 5.1, which are not part of the explanation/prediction of the SSD phenomenon; these control variables serve as predictors in the regression analysis to obtain more precise estimates of the causal effects corresponding to the hypotheses shown above. The middle variables in the above relationships (i.e. FC and PFR) are the mediators.




**Note:** *R* is a binary control variable representing the farming region (0 = Upcountry and 1 = Low Country), while *H* is a continuous control variable representing herd size. The hashed lines in light grey, extending from the three farmer development constructs to the three farmer sustainable performance constructs, indicate artificial paths created to demonstrate the robustness of the theoretical model (collectively represented by *H1* to *H9c*) through the specification of the null hypothesis, *H10.*

**Figure 5.1 Theoretical model**

*(Source: Own work)*

The theoretical model (Figure 5.1) specifies *only indirect relationships* between the three FD initiatives and sustainable farmer performance. Consequently, causation of sustainable farmer performance occurs solely because: an increase (or decrease) of FD initiatives causes FC to increase (or decrease), which in turn causes sustainable farmer performance to increase (or decrease); or an increase (or decrease) of FD initiatives causes PFR to increase (or decrease), which in turn causes sustainable farmer performance to increase (or decrease). In statistical language, this means that given the specified relationships in the model (Figure 5.1), supposing direct relationships are specified between the FD initiatives and sustainable farmer performance (in a multiple regression sense, making FD initiatives also as predictors of sustainable farmer performance) for whatever reason, such relationships would be statistically nonsignificant due nonsignificant regression coefficients corresponding to the newly specified direct relationships (see Nitzl et al., 2016, p. 1855 for full details). One can consider testing H10 purely as a robustness check of the theoretical model. To support the null hypothesis that there is no direct relationship between FD initiatives and sustainable farmer performance, the following null hypothesis is specified:

**H10.** FD has no direct effect on farmer performance.

## 5.3 Methodology

### 5.3.1 The study context

Sri Lanka is a small island (65,610 $km^2$) south of India; it is a lower-middle-income country with a population of 22 million. Sri Lanka's domesticated cattle population amounts to 1,574,918, of which 33% are milking cows that produce 418 million liters of milk approximately (Department of Animal Production and Health, 2023). The country is divided into 22 administrative districts and the two districts covered in the fieldwork, Nuwara Eliya (a major district in the upcountry region) and Kurunegala (a major district in the low country region) are the highest milk production districts. Due to contrasting climatic conditions, the type of cows being raised for milking, and farming methods differ across the two districts.

Due to the cool climate, farmers in Nuwara Eliya primarily raise exotic high-milk-yielding cows, such as Jersey and Holstein-Friesian breeds. However, unlike in Australia and New Zealand—the countries where the heifers originated—Nuwara Eliya lacks large grazing areas. As a result, farmers mainly rely on commercial dry rations to feed their cows. In contrast, farmers in Kurunegala, who raise local or local-Indian crossbreeds—suited to the hot climate benefit from an abundance of natural forage for their cattle (Hitihamu et al., 2021).

Although there are nearly 21 milk processing companies in Sri Lanka (Hitihamu et al., 2021), farmers belonging to one large privately-owned milk processor were selected for this study due to the following three reasons: the company has its bank to support their farmers financially (this relates to FS in the theoretical model), has milk collection/chilling centers around the country with a strong presence in Nuwara Eliya and Kurunegala districts. The processor has a documented farmer training schedule and deploys their extension officers to provide onsite training and arranges training sessions occasionally through their milk collection centers for farmers who own more than five milk-bearing cows or produce more than 20 Liters/day, which is also the farmer inclusion criteria of the study. The nature of training can be classified as quasi-voluntary.

### 5.3.2 Data collection instrument

The extant literature was used to identify the indicators of the eight constructs in the theoretical model. These indicators were translated into statements (Chapter 5, Appendix 1), which were included in a survey questionnaire that was administered to dairy farmers in the two districts. Section A of the questionnaire covered statements to represent the indicators of the constructs. Agreement to each statement was sought from the farmers via a five-point scale. Section B of the questionnaire covered a range of farmer demographics/information; the ones used in the statistical model as control variables are herd size, region (Nuwara Eliya=0, Kurunegala=1), additional training received over and above the regular training of training conducted at the farm by the milk company's extension officer when they visit the farm, and occasional invited short training at the milk company's milk collection center (No=0, Yes=1). The content validity of the questionnaire was established by following three steps. Firstly, the questionnaire was pretested for clarity and relevance by consulting four experts: two academics knowledgeable about the context and two senior practitioners in the Sri Lankan dairy industry. Thereafter, the questionnaire was translated into native languages: Sinhala and Tamil. Translations and back-translations were done by independent translations, and the tallying was done by the first author (Fowler Jr, 2013). Thirdly, the questionnaire was pilot tested using 30 randomly selected farmers. This helped in removing overlapping statements and reshaping statements for simplicity and consistency (Fowler Jr, 2013).

### 5.3.3 Sample selection and survey administration

Of the 15,858 farmers found in the milk processor's register, 3,172 belonged to Kurunegala and 1,205 belonged to Nuwara Eliya. Of the 3,172 farmers in Kurunegala, 792 (25%) passed the inclusion criteria, while of 1,205 farmers in Nuwara Eliya, 772 (64%) passed the inclusion criteria. Four hundred farmers (two hundred from each district) were randomly selected from sampling frames (Nuwara Eliya eligible farmer list and Kurunegala eligible farmer list) for data collection. Of the 400 invited to participate via phone, 324 agreed. Data was collected by 4 trained research assistants (two for each district) who visited the farms during April-June 2023. Of the 324 farmers who participated in the study, 155 were from Nuwara Eliya and 169 were from Kurunegala. The average herd sizes of Nuwara Eliya and Kurunegala farmers were

5.4 and 11.6 respectively. The average per cow daily milk productivity for Nuwara Eliya and Kurunegala farmers was 8.3 Liters and 2.5 Liters respectively.

### 5.3.4 Specifying the statistical model and analyzing the data

Figure 2 depicts the specified statistical model (before conducting the robustness check to test H10) with the estimated standardized regression coefficients. The control variable IP (the binary coded variable with a No/Yes to the question: have you received training over and above regular training?) was used as an additional predictor (labelled IP in Table III) of ES, SS, and EnvS. In testing the theoretical model, both regions were analyzed together, as the purpose of this study is to estimate the average effects for the population and generalize the explanation of the phenomenon of SSD.

The partial least squares structural equation modelling (PLS-SEM) technique was used to test the theoretical model, mainly because it contained formative constructs, which do not pose problems in PLS-SEM (Hair et al., 2019, p. 5). Four of the eight constructs in the theoretical model (Figure 1), namely FS, ES, SS, and EnvS are formative constructs corresponding to indexes rather than scales. By definition, formative constructs rely on their indicators to form and shape the meaning of the constructs whereas constructs that possess psychometric properties (e.g., behavioral constructs) do not rely on its measures to form or shape their meanings (Diamantopoulos & Winklhofer, 2001; Hair Jr et al., 2022). The second reason why PLS-SEM was used was the exploratory nature of the study which involves conducting a robustness check—testing H10 which required creating nine more paths—that resulted in an already complex model even more complex (Hair et al., 2019, p.5). PLS-SEM was conducted using SmartPLS4 software. Missing data (just 0.01%) were imputed using the 'mean replacement' method included in the software. Since the data were collected via a self-administered survey, two tests—Harman's single factor test (Podsakoff *et al.*, 2003) and the full collinearity test (Kock, 2015)—were conducted to demonstrate the absence of common method bias (CMB).

In PLS-SEM, the validity of the measurement model is assessed first, followed by an evaluation of the structural model to test the hypothesized relationships between the constructs (Hair Jr et al., 2022). In Figure 5.2, the measurement model shown encompasses all the relationships between the indicators of the constructs and the constructs themselves, while the structural model represents the hypothesized causal relationships between the constructs.

## 5.4 Results

### 5.4.1 Demonstrating the validity of the measurement model

Scale reliability is a requirement to establish the validity of reflective constructs (i.e., constructs possessing psychometric properties) (Hair Jr et al., 2022). Cronbach's alpha and composite reliability (CR) coefficients ($\rho_c$) were used to demonstrate scale reliability (Table 5.1). In PLS-SEM, the validity of reflective constructs is demonstrated by establishing convergent validity and discriminant validity. Convergent validity is established using the average variance extracted (AVE) by each construct; strong factor loadings (ideally>0.707; minimally>0.60) provide additional evidence of convergent validity (Hair Jr et al., 2022). The discriminant validity of the reflective constructs can be established by examining the heterotrait-monotrait (HTMT) ratios of correlations between the constructs (Henseler et al., 2015). The HTMT test is the most robust test on discriminant validity (Hair Jr et al., 2022). As shown in Table 5.2, the four reflective constructs easily met the reliability, convergent validity, and discriminant validity criteria.

**Table 5.1 Reliability and validity measures**

| Construct | Scale Reliability | | Convergent Validity | Discriminant Validity (HTMT Matrix) | | | |
|---|---|---|---|---|---|---|---|
| | Cronbach's alpha | CR rho-C | AVE | FT | EFFQP | FC | PFR |
| FT | 0.973 | 0.979 | 0.904 | | | | |
| EFFQP | 0.870 | 0.920 | 0.793 | 0.579 | | | |
| FC | 0.833 | 0.890 | 0.672 | 0.522 | 0.706 | | |
| PFR | 0.707 | 0.830 | 0.632 | 0.453 | 0.800 | 0.736 | |
| Threshold value | >0.70 Hair Jr *et al.* (2022) | >0.70 Hair Jr et al. (2022) | >0.50 Hair Jr et al. (2022); Fornell and Larcker (1981) | <0.85 Hair Jr et al. (2022); Henseler *et al.* (2015) | | | |

In PLS-SEM, the validity of the formative constructs (in this study FS, ES, SS, and EnvS) is established using the criteria prescribed by Hair Jr et al. (2022), which requires the measures of the formative constructs showing no multicollinearity (variance inflation factor<5.0) and the weights of the indicators to be significant ($p$<0.05), and when not, its correlation with the construct should be>0.50; these conditions were met by the measurement model.

### 5.4.2 Assessing and discussing the structural model

*5.4.2.1 The $R^2$ values of endogenous constructs and the significance of control variables*

Table 5.2 depicts the $R^2$ values of the endogenous constructs (the constructs whose variability has been explained by their predictor constructs). The $R^2$ values suggest that the hypothesized model is useful in predicting and explaining the effects of the hypothesized causal relationships.

One thing that stands out is that the $R^2$ of FC drops ($\Delta R^2$) markedly when the control variables are excluded. From Table 5.3, it becomes clear that the only control variable that makes any practically noticeable impact on an endogenous construct is R, the farming region, which appears to impact FC and EnvS. These results are further reviewed in section 5.4.2.4.

**Table 5.2 Change in $R^2$ values associated with the endogenous constructs**

| Construct | $R^2$ with control variable | $R^2$ without control variable | $\Delta R^2$ when control variables are excluded |
|---|---|---|---|
| FC | 75.94% | 51.83% | 24.11% |
| PFR | 62.98% | 62.62% | 0.36% |
| ES | 45.29% | 44.38% | 0.91% |
| SS | 38.67% | 36.85% | 1.82% |
| EnvS | 46.18% | 41.79% | 4.39% |

**Table 5.3 Regression coefficients of control variables and their significance**

| Control variable | The endogenous construct | | | | |
|---|---|---|---|---|---|
| | FC | PFR | ES | SS | EnvS |
| R | **1.258** (p<0.001) | 0.149 (p=0.155) | 0.244 (p=0.067) | -0.348 (p=0.041) | **0.771** (p<0.001) |
| H | 0.051 (p=0.049) | -0.058 (p=0.179) | 0.041 (p=0.159) | 0.005 (p=0.443) | 0.006 (p=0.427) |
| IP | N/A | N/A | -0.035 (p=0.353) | 0.155 (p=0.070) | 0.223 (p=0.014) |

*5.4.2.2 Testing the hypotheses underpinning the theoretical model*

The standardized structural regression coefficients estimated via PLS-SEM, their *p*-values, and the localized effect sizes ($f^2$) of the causal variables are shown in Table 5.4. It must be noted that the *p*-values reported in Table 5.4 are based on the bootstrapping technique (for details see Hair Jr et al., 2022). The settings used for bootstrapping were: 5000 samples, one tailed test, and percentile bootstrap as the confidence interval method. The reason for using one-tailed tests was that only positive effects are hypothesized and thus the alternative hypothesis should be effect > 0.

The results in Table 5.4 indicate that at a 0.05 significance level, four hypotheses (H3, H4, H7, and H8c) have not been supported by the data, but there is weak support for H3, H7, and H8c ($p<0.10$). The data outrightly rejects H4, but neither this unsupported hypothesis nor the three weakly supported hypotheses threaten the overall explanation of the SSD phenomenon—FD initiatives have a positive effect on sustainable farmer performance, through the mediators FC and PFR—that the theoretical model (Figure 5.1) represents. The effect size ($f^2$) estimates in Table 5.4 indicate the impact a particular construct makes in predicting the endogenous construct in terms of $\Delta R^2$ (e.g. the small effect of $f^2$=0.032 gives an idea of the size of the impact FT has in predicting FC, given FC is also being predicted by FS and EFFQP).

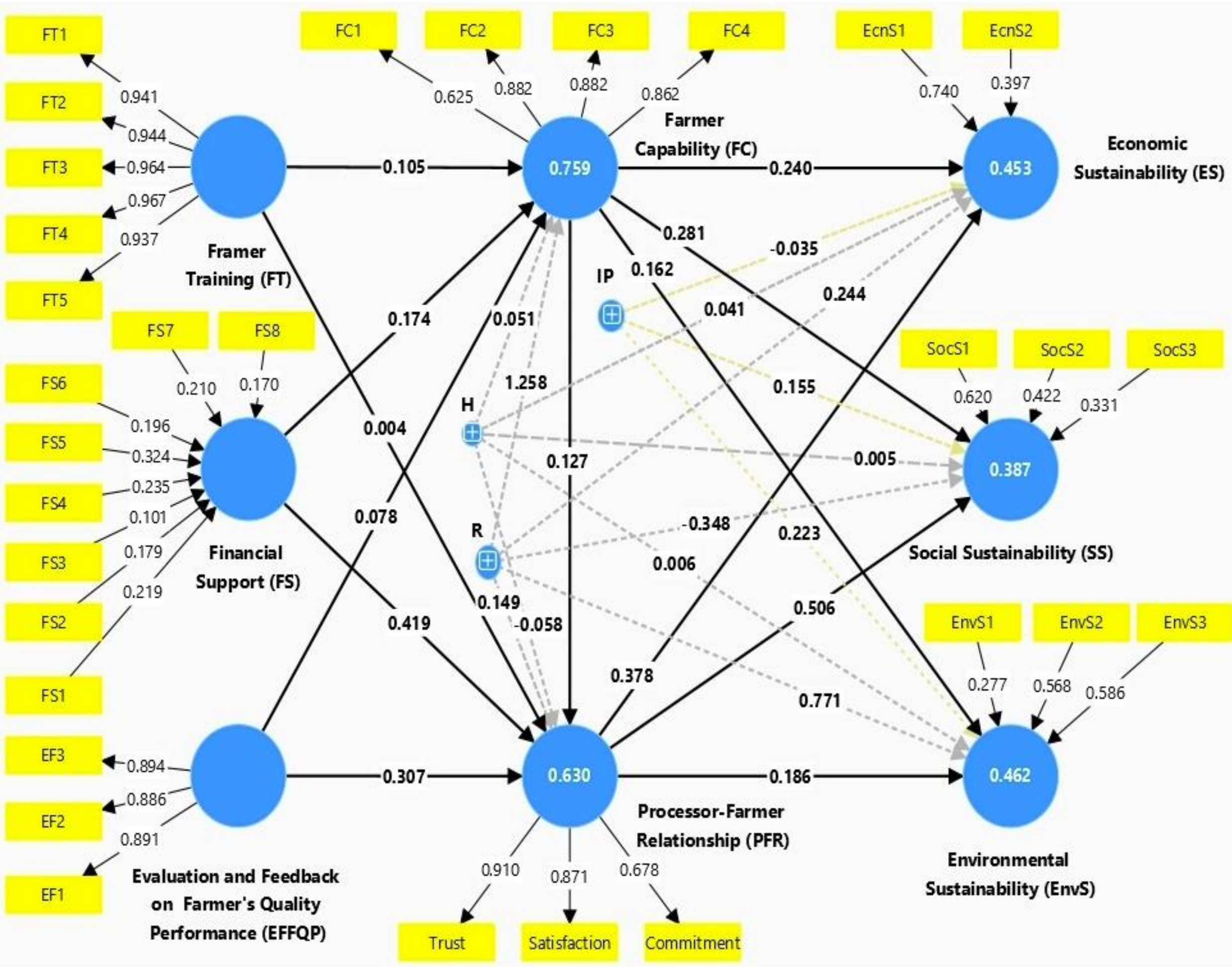
**Table 5.4 Test results on the hypotheses**

| **Relationship** | **Standardized Regression coef.** | ***5% Boundary of the CI*** | ***p*-value** | **Localized Effect size ($f^2$)** |
|---|---|---|---|---|
| H1: FT→FC | 0.105 | 0.042 | 0.003 | 0.032 |
| H2: FS→FC | 0.174 | 0.091 | 0.001 | 0.053 |
| H3: EFFQP→FC | 0.078 | -0.005 | 0.056 | 0.011 |
| H4: FT→PFR | 0.004 | -0.073 | 0.466 | 0.000 |
| H5: FS→PFR | 0.419 | 0.346 | 0.000 | 0.190 |
| H6: EFFQP→PFR | 0.307 | 0.207 | 0.000 | 0.111 |
| H7: FC→PFR | 0.127 | -0.028 | 0.079 | 0.010 |
| H8a: FC→ES | 0.240 | 0.100 | 0.003 | 0.025 |
| H8b: FC→SS | 0.281 | 0.131 | 0.003 | 0.030 |
| H8c: FC→EnvS | 0.162 | 0.018 | 0.083 | 0.011 |
| H9a: PFR→ES | 0.378 | 0.290 | 0.000 | 0.155 |
| H9b: PFR→SS | 0.506 | 0.412 | 0.000 | 0.246 |
| H9c: PFR→EnvS | 0.186 | 0.112 | 0.000 | 0.038 |

**Note:** *Based on the guidelines of Cohen (1992),* $f^2$=0.02 is a small effect; $f^2$=0.15 is a medium effect; $f^2$=0.35 is a large effect (anything in-between can be interpreted using these signposts). Since one-tailed testing was used ($H_0$: Effect = 0; $H_1$: Effect > 0), there is no upper bound CI for the parameter estimates.

### *5.4.2.3 The indirect effect of FD initiatives on sustainable farmer performance*

Subject to H10 being supported by the data (section 4.2.5), an FD initiative has only an indirect effect on sustainable farmer performance via a set of mediated relationships (Figure 5.2). To examine how these mediated relationships in the model have worked (e.g. the FT is linked to ES via many indirect links, as shown in Figure 5.2), the total indirect effects and their statistical significance were examined. Table 5.5 depicts the results. Given the definition of SSD, examining the total indirect effects of FD initiatives on farmer sustainable performance is essential to establish the fact that FD initiatives (ideally all three: FT, FS, and EFFQP) positively—albeit indirectly—impact at least two of the three TBL metrics of farmer sustainable performance.




**Note:**

Figures on the blue circles are the R^2 values of the endogenous constructs.

The figures in de-emphasised paths (shown in hash grey colour) show the regression coefficients of the control variables.

The incoming arrows from the indicators to a construct shows that the construct is formative.

The outgoing arrows from the construct to its indicators shows that the construct is reflective.

The indicator weights are shown for formative constructs while the indicator loadings are shown for reflective constructs.

**Figure 5.2 SmartPLS output of the statistical model**

*(Source: Own work)*

To illustrate what a total indirect means, the FT to ES indirect effect of 0.032 (Table 5.5) is explained as follows: supposing FS and EFFQM remain unchanged if FT is increased by one standardized unit, ES would increase by 0.032 standardized units due to the indirect paths specified in the model; this increase though is only weakly significant (p=0.065). In summarizing the results shown in Table 5.5, it can be stated that FS and EFFQP do have a significant positive effect on all three TBL metrics of sustainable farmer performance—though the mediators FC and EFFQP—but FT has only a weakly significant effect (0.05<$p$<0.10).

**Table 5.5** **Total indirect effects and their significance**

| Indirect Relationship (via FC and PFR) | Total Indirect Effect | *p*-value |
|---|---|---|
| FT to ES | 0.032 | 0.065 |
| FT to SS | 0.038 | 0.074 |
| FT to EnvS | 0.020 | 0.098 |
| FS to ES | 0.208 | 0.000 |
| FS to SS | 0.272 | 0.000 |
| FS to EnvS | 0.110 | 0.001 |
| EFFQP to ES | 0.138 | 0.000 |
| EFFQP to SS | 0.182 | 0.000 |
| EFFQP to EnvS | 0.071 | 0.001 |

*5.4.2.4 The farming region as a predictor of FC and EnvS*

Although the farming region (R) is not a theoretical variable, as mentioned earlier, as a control variable, it acts as an influential predictor of FC and EnvS (Table 5.3). The results imply that given the specified model, Kurunegala farmers are 1.258 standardized units (i.e., 1-5 scale is used to collect data) more capable than Nuwara Eliya farmers, on average (=1.597 in standardized units). Similarly, results imply that given the specified model, Kurunegala farmers are 0.771 standardized units more environmentally sustainable than Nuwara Eliya farmers, on average (=0.679 in standardized units).

A possible reason for the lower FC returned for Nuwara Eliya farmers could be that the questionnaire justifiably assesses FC based on relative performance (e.g., relative to the milk processor's expectations regarding the quantity of milk supplied, as detailed in Chapter 5, Appendix 1). Consequently, farmers in Nuwara Eliya may have chosen response options that result in lower scores for FC because the exotic cows they raise (e.g., Jersey and Holstein-Friesian breeds) are expected to produce more milk, setting higher benchmarks. In contrast, Kurunegala farmers, who primarily raise local or local-Indian crossbreeds, face lower production targets. Additionally, Kurunegala farmers benefit from lower feeding costs, as they do not regularly purchase commercial dry rations. The two-way interaction plot shown in Figure 5.3 suggests that FT has resulted in an improvement of FC for Nuwara Eliya farmers on average but not for Kurunegala farmers. It could be possible that through training, Nuwara Eliya farmers learn more about farming practices on raising exotic cows.

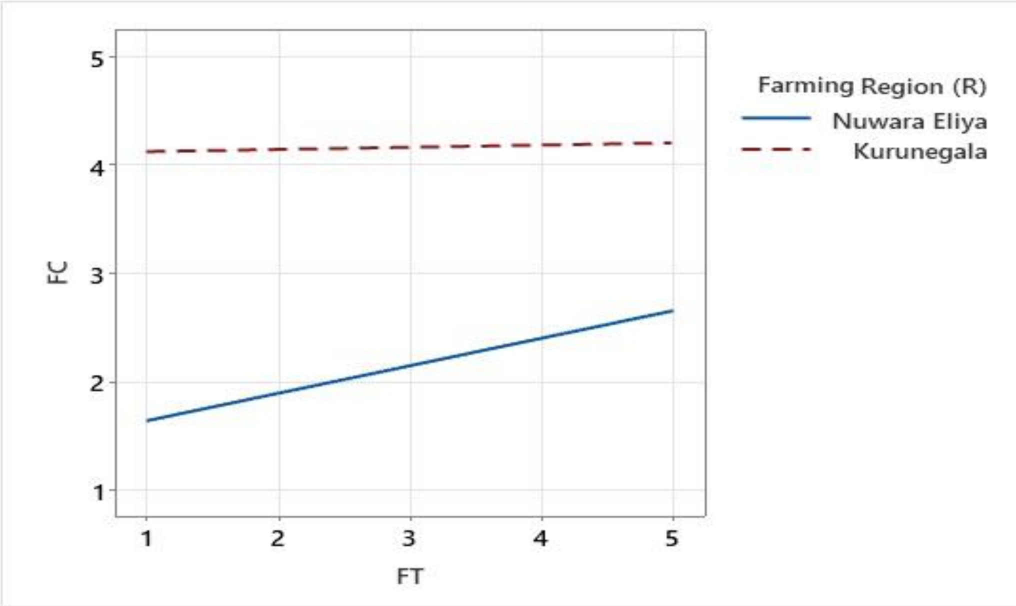


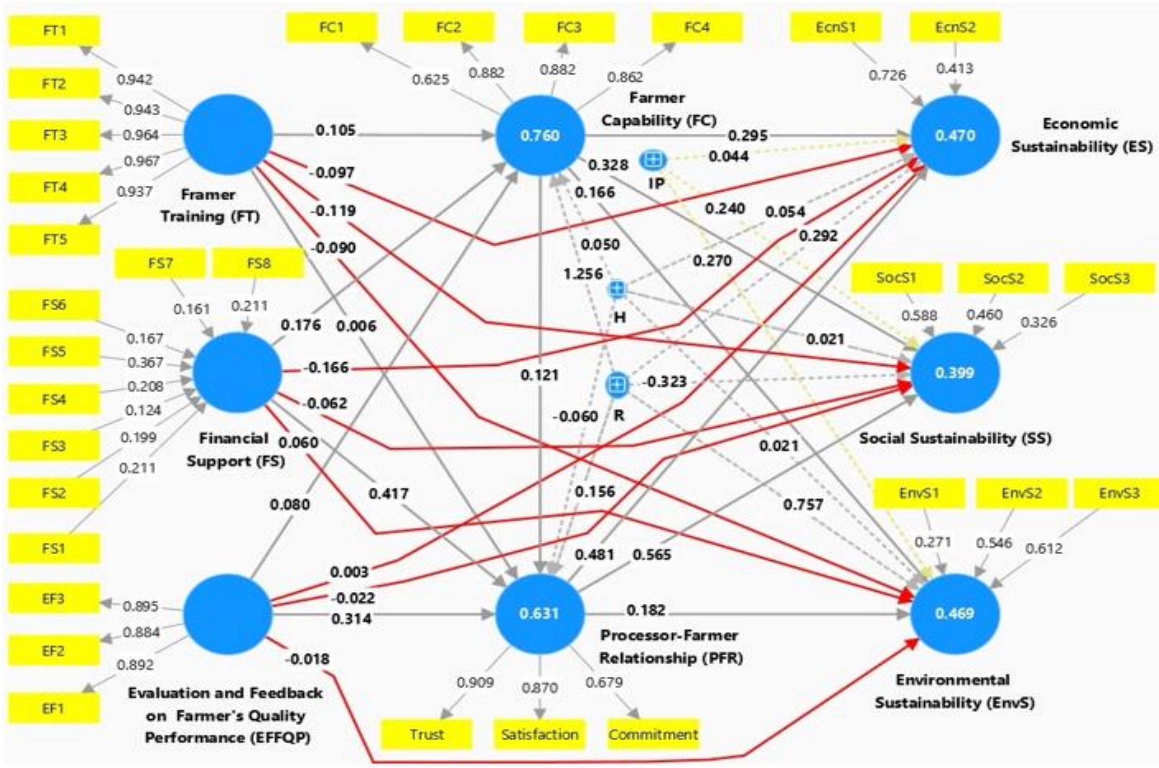

**Figure 5.3 The two-way interaction between FT and the region on FC**

(Source: Own work)

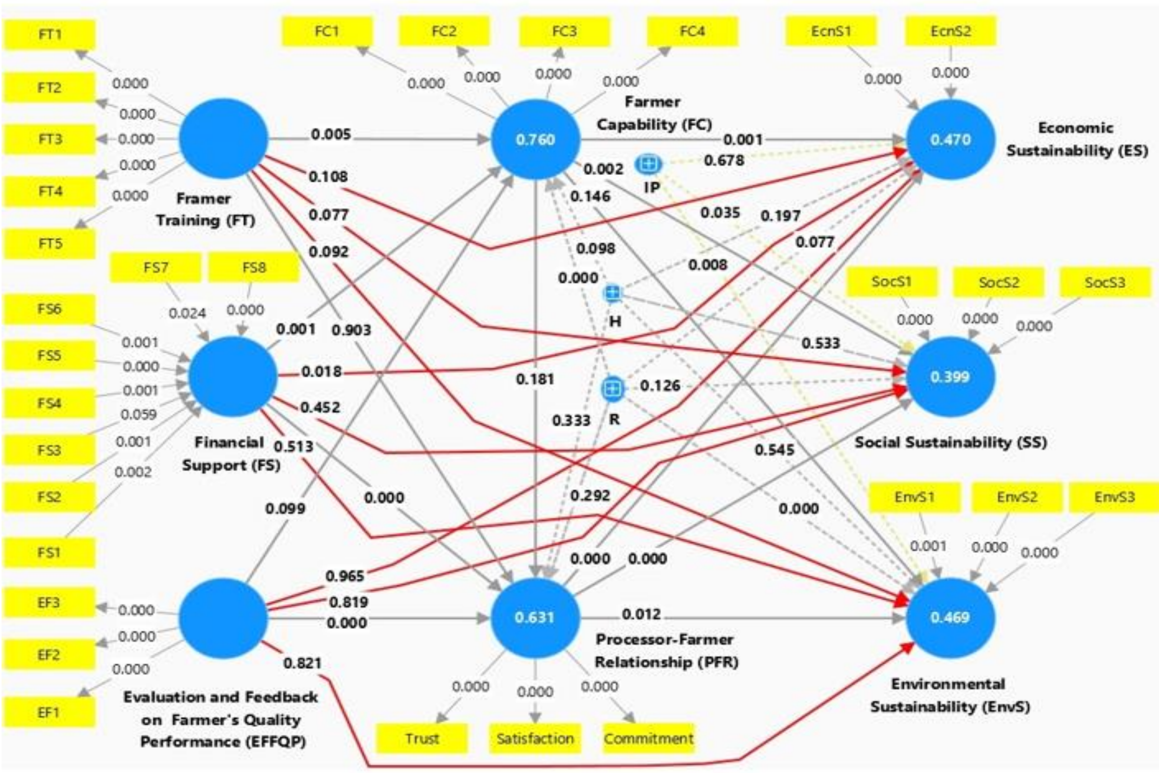
*5.4.3.5 Testing H10*

To test H10, which posits that FD does not have a direct effect on sustainable farmer performance, nine direct paths between the three FD initiatives (FT, FS, and EFFQP) and the three TBL metrics on sustainable farmer performance were created. These paths are shown in red color in Figure 5.4 to focus the attention of the reader on the paths under scrutiny. The top panel of Figure 5.4 shows the estimated regression coefficients of the predictors (path coefficients) while the bottom panel shows the p-values of these predictors.

Out of the nine direct effects forced into the existing hypotheses to test H10, eight can be removed summarily, as they are not nonsignificant ($p$>0.05). The FS→ES direct link returned a path coefficient of -0.166 ($p$=0.018), which is statistically significant. Due to this negative direct effect, the overall effect of FS on ES (direct effect + total indirect effects) turned up as 0.097 ($p$=0.180), which is nonsignificant. Earlier (without the direct effect) total effect of FS on ES (= total indirect effect) turned up as 0.208 and significant ($p$<0.001), as shown in Table VII. Thus, it is argued that the FS→ES direct link forced into the existing set of hypotheses, for the sake of testing H10 as a robustness check of the theoretical model (Figure 5.1), can also be removed on the grounds of untenability. Thus, it is concluded that the data supports H10.




Panel 1: Standardised coefficients when testing H10




Panel 2: p values of the coefficients when testing H10

**Figure 5.4 SmartPLS output of the statistical model for testing H10**

(Source: Own work)

## 5.5 Discussion

### 5.5.1 The impact of FT on FC

The results of this study imply that the impact of FT on FC is small (Table 5.4), which was largely responsible for FT having only a weak effect on sustainable farmer performance (Table 5.5). The hypothesized theoretical model (Figure 1), which was supported by the data (Figure 5.2), only considers the main effect of FT on FC, but the FT*Region two-way interaction plot (Figure 5.3) sheds light on how training might have worked in the two regions: worked for Nuwara Eliya farmers but not for their Kurunegala counterparts. Nuwara Eliya farmers need the technical know-how to raise exotic cows, whose ancestry is Australia and New Zealand. Training may be providing more benefits (leverage) to them than their Kurunegala counterparts. The literature suggests that knowledge of dairy farming and the use of improved dairy management practices are essential in improving the profit margin of farmers (Kataike et al., 2018; Mariammal et al., 2018; Wouters et al., 2007) and the livelihood of dairy farmers (Thakur et al., 2022, Wouters et al., 2007). The results of the present study do not necessarily contradict the literature.

The results in Table 5.4 suggest that if FT is increased by 1 standardized unit, FC is increased only by 0.105 standardized units (i.e. 10.5%), if all other factors remain unchanged. This apparent low gain seems to imply that the training provided by the milk processor may not be very effective in improving the capability of the farmers when both regions are considered. In conclusion, on the strength of what Figure 5.3 implies, it is suggested that it is not the quantity of training that matters but its quality and relevance—a suggestion consistent with the literature (Kirkpatrick & Kirkpatrick, 2006; Ragasa & Mazunda, 2018; Raina et al., 2017).

### 5.5.2 FT as a driver of farmer sustainable performance

As mentioned earlier, based on results shown in Table 5.5, the effects of FT on the three TBL metrics ES, SS, and EnvS are nonsignificant at 0.05 level. This, coupled with the low impact of FT on FC has a significant impact on the milk processor because arguably, they invest more in FT, than in FS and EFFQP. Thus, it seems that neither the milk processor nor their farmers, in general, achieve much benefit from FT in its current form. The following possible reasons are suggested for the nonsignificant effect of FT on farmer sustainability:

Providing training to a large number of farmers (mass training) is quite challenging and in such situations, the relationships can gravitate towards a transactional/arm's-length relationship

(Krause et al., 2007; Monczka, 2020). This might also be the reason why data did not support the FT→PFR link (H4). Although the study covered farmers who receive training (according to the milk processor's register), the translation of training into action can be impaired by barriers, such as insufficient capital to invest in implementing the needed changes (Balana & Oyeyemi, 2022; Luther et al., 2018; Rogers, 1962); and, once FC improves over time, again it takes time for the farmer to realize the benefits of improved FC in the form of financial, social, and environmental benefits (Luther et al., 2018, Susanty et al., 2018).

As regards focused training—tailoring training to suit the training needs of a specific farmer group—the literature refers to the establishment of farmer training centers/farmer field schools and mobile training units to provide non-formal education as an efficient method of reaching out to farmers (Chopde et al., 2019; Mariyono, 2019; Mariyono et al., 2022). The training centers may also provide an opportunity to enhance the relational capability of farmers and make the relationships more collaborative as opposed to transactional (Mariyono et al., 2022).

The literature (e.g., Bánkuti et al., 2020; De Silva et al., 2023; Korale-Gedara et al., 2023; Pedroso et al., 2021) also refer to training farmers on the adoption of environmentally friendly farming practices which the present study did not support (the nonsignificant effect of FT on EnvS). Since the price being paid to a farmer for supplying milk is directly linked with the quality of the milk (Korale-Gedara et al., 2023), the training can include imparting knowledge on food safety and quality (Naganboyina & Kaple, 2022; Susanty et al., 2018).

### 5.5.3 The impact of FS on FC and farmer sustainable performance

The regression coefficient corresponding to the FS→FC path is 0.174, which is much higher than the FT→FC link (=0.105) and the EFFQP→FC link (=0.078, and nonsignificant) implying that of the three FD initiatives, FS has been the most effective (this is also evidenced from the $f^2$ effect size values reported in Table 5.4) in impacting FC positively. The reason for FS to emerge as the most important influencer of FC could be that what farmers need the most is FS, to improve their capability. The results also show that of the three FD initiatives, FS is the most important influencer/driver of a farmer's SS (Table 5.5). A similar finding was reported by Susanty et al. (2019) in the Indonesian dairy farming context. Also, FS enables a farmer to implement the necessary quality and productivity improvement interventions and expand the business to be socially and economically better off (De Silva and Sandika, 2012, Yawar and Seuring, 2018). Brix-Asala et al. (2021) reasoned that credit provided by processors in a developing economy enables smallholder farmers to overcome their hurdles in using the credit to improve their business gradually by being able to purchase equipment or machinery to improve their productivity/capability.

Korale-Gedara et al. (2023) found that in the Sri Lankan context, financially assisted farmers tend to adopt safer practices to ensure that the quality of milk being supplied meets food safety and quality standards. For example, they found that dairy farmers in Sri Lanka who receive FS to build or renovate cattle sheds improved milk storage capacity, milk hygiene, and effluent/waste disposal. Similarly, Chari et al. (2023) argued that FS by way of providing farming equipment has a positive effect on farmers' ES. The present paper does not look at individual FS initiatives as FS was treated as a composite variable. However, the findings of this paper do not contradict the findings of Chari et al. (2023) and Korale-Gedara et al. (2023). As mentioned earlier, the results suggested that the real gains of FS on sustainable farmer performance come through PFR, rather than through FC, judging by the regression coefficients in the mediated paths (Figure 5.2). This is something that is not highlighted much in the literature.

The results (Table 5.5) also show that FS influences SS (effect=0.272) and EnvS (effect=0.110) more positively than FT and EFFQP. The literature suggests that supporting farmers financially to promote environmentally friendly farming practices such as home gardening, action to reduce methane gas emissions, establishing domestic biogas plants, and implementing an effective wastewater management system has been useful in reducing the carbon footprint in agriculture (Bhat et al., 2022; Peterson & Mitloehner, 2021; Susanty et al., 2019).

### 5.5.4 The impact of EFFQP on FC and sustainable farmer performance

The EFFQP→FC relationship returned a nonsignificant effect ($p$=0.056), which can be interpreted as a weak effect as mentioned earlier. Since FC reflects farmer productivity in terms of milk volume, quality, and milk supply continuity, the weak link could mean that the milk processor has not been receiving the benefit that they expect from EFFQM. The literature argues that supplier evaluation and feedback improve suppliers' capability, which in turn improves their sustainable performance (Benton et al., 2020; Monczka, 2020; Wagner, 2009). The literature on agriculture suggests that providing feedback to farmers to improve quality and productivity is quite common in that field (Kosgey et al., 2011; Sah et al., 2020). However, according to the literature, the feedback seemed to have come from dedicated extension service providers rather than from processors, who can only offer extension services to a limited extent.

Even though EFFQP seems to have a weak impact on FC, it has impacted positively on sustainable farmer performance due to PFR taking over the mediator role from FC—the mediation paths EFFQP→PFR→ES and the EFFQP→PFR→SS are associated with higher regression coefficients, as evidenced from the results shown Table 5.4.

## 5.6 Conclusion

The aim of this study was to develop and test a theoretical model to ascertain to what extent SSD initiatives implemented by a milk processor result in improved TBL outcomes of dairy farmers. The theoretical model developed (Figure 5.1) posits that SSD initiatives (FD initiatives) implemented by the milk processor in the form FT, FS, and EFFQP positively impact the TBL outcomes of their dairy farmers–indirectly through the mediating variables FC and PFR– thus demonstrating that SSD has taken place in the study context.

FC and PFR are both important to the milk processor because improved FC and PFR benefit them in maintaining a continuous flow of milk in their production line by being able to purchase good quality milk year-round in higher volumes through farmers who are likely to retain with them. In achieving this goal, the milk processor invests in FD and expects a reasonable return for their investment. The study found that FT has only a small effect on FC, which may not be a sufficient return on the milk-processor's investment. In addition, the study found that FT does not seem to affect PFR. These findings (FT's weak influence on the two mediating variables) meant that FT is incapable of transmitting a significant impact on sustainable farmer performance. However, the study found that the remaining two FD initiatives do positively impact all three sustainable farmer performance metrics. Relative to EFFQP, FS seems to have a greater impact on sustainable farmer performance; FS also seems to have a notable impact on FC and PFR (especially the latter), which implies that providing FS may also be beneficial to the milk processor. At a 0.05 significance level, EFFQP did not have an impact on FC ($p=0.056$), questioning the role of this FD initiative in improving farmer productivity.

One theoretical implication of the study is that the concept of SSD applied in operations and SCM fields can be applied in agri-food SCs. Another theoretical implication is that because there is no direct relationship between FT and sustainable farmer performance unless the FT is modified for it to have a strong effect on FC, it is not going to positively impact sustainable farmer performance. FS on the other hand showed evidence of improving FC and sustainable farmer performance.

There are several practical implications of the study. One practical implication is that the type of FT being provided to farmers to improve their productivity must consider the production factors—Nuwara Eliya farmers who raise exotic cows seemed to have gained from training. Another practical implication is that feedback that farmer receives on milk quality (operationalized by EFFQP) needs to be modified by the milk processor for it to have a notable positive impact on them and their farmers. Yet another practical implication is the relatively high positive impact FS (as a form of FD initiative) has on SS. Improved SS through FS implies better education for the children and more worthy farmers to the society due to interactive farming activities such as helping fellow farmers—all of which may create a positive impact on the society (see indicators of SS shown in Chapter 5, Appendix 1).

The weak links between the FD initiative and FC have policy implications. This finding implies that FD should not be left almost entirely in the hands of the privately-owned processor because it is quite challenging to improve the capability of so many farmers efficiently by implementing a multitude of highly tailored programs for farmers who are likely to be heterogeneous (not within the scope of this study to examine farmer heterogeneity). A privately owned milk processor will be more cognizant of the returns for their investments. While it is acknowledged that the governments of most low and low-middle-income countries have limited money to invest in FD, the findings suggest that the government may need to get more involved in developing dairy farmers. One possible avenue for the government to get more involved in FD is through a private-public partnership or more incentivization of private milk processors who actively engage in farmer development. Governments and regulatory bodies can also improve FC by developing and enforcing milk quality standards and environmental standards to promote cleaner production. These measures would force farmers to self-improve to stay in business, and having such farmers would also benefit milk processors because it is much easier to support farmers who self-improve. This said the governments and regulatory bodies must gradually enforce the standards allowing farmers to adapt to the new norms.

While the theoretical model and the findings of the study would be useful to academia, policymakers and the dairy industry in a developing economy, the study is not without its limitations. Firstly, the responses are based on the perception of the respondents. For example, the judgements on farmer sustainability have been made with reference to the goals being set by the individual farmer. A farmer may feel that they are economically and socially well-off, but they may not be as well-off as they perceived. The same can be said about the judgement on FC. Another limitation is that the theoretical model has been tested in a reasonably favorable environment for theory testing (e.g. the milk processor has its bank to support its farmers, the inclusion criteria being used for the survey, and the non-existence of other major players that are strictly involved in FD). For this reason, the generalizability of the findings of this study should made with some caution.

It is suggested that the study be repeated in other agri-food contexts ideally incorporating more objective judgments on FC and sustainable farmer performance. Another attractive proposition might be to depart from SSD theory testing to a more direct approach of examining the relationship between FT, FS, and EFFQP—including their two-way interactions—and farmer productivity. Yet another possibility might be to conduct a longitudinal study to examine how tailored FD programs work over a period. Finally, it is useful to collect quantitative and qualitative data from the processor/s to get their perspective such as their expectations on FD.

## Chapter 5, Appendix 1: The constructs, indicators and literature used

| Construct | Indicator label | Statements used for each indicator (One statement per indicator) | Literature used for indicator development |
|---|---|---|---|
| **FT** Farmer training | FT1 | My milk processor provides sufficient training on how to increase milk production | Aniagyei et al. (2024); Brix-Asala et al. (2021); De Silva et al. (2023); Ladele and Kuponiyi (2006); Thakur et al. (2022); Yawar and Seuring (2020) |
| | FT2 | The milk processor provides sufficient training in animal health and care | |
| | FT3 | My milk processor provides sufficient training on improving milk quality | |
| | FT4 | My milk processor provides sufficient training in farm business management | |
| | FT5 | My milk processor provides sufficient training on sustainable farming practices | |
| **FS** Financial support | FS1 | My milk processor provides loans to improve my dairy business | Brix-Asala et al. (2021); Chopde et al. (2019); De Silva et al. (2023); Mukucha and Chari (2021) |
| | FS2 | My milk processor provides financial support to purchase dairy equipment | |
| | FS3 | My milk-processor provides financial support during hardship | |
| | FS4 | My milk processor provides animal feed at reduced prices | |
| | FS5 | My milk processor provides animal feed on a credit basis | |
| | FS6 | My milk processor arranges third-party animal health and welfare services | |
| | FS7 | My milk processor offers a better price for high-quality milk | |
| | FS8 | The milk processor makes timely payments | |
| **EFFQP** Evaluation and feedback on farmer quality performance | EF1 | My milk processor shares information on milk quality improvement methods | Brix-Asala et al. (2021); De Silva et al. (2023); Ladele and Kuponiyi (2006); Yawar and Seuring (2018) |
| | EF2 | My milk processor has an efficient platform to share my milk quality information for transparency | |
| | EF3 | My milk processor provides timely feedback on milk quality issues | |
| **FC** Farmer capability | FC1 | I can practice what learned via training provided by my milk company | De Silva et al. (2023), Nath *et al.* (2010), Sachitra and Chong (2018) |
| | FC2 | I can maintain close relationships with extension service officers | |
| | FC3 | I can supply the milk quantity my milk processor expects year-round | |
| | FC4 | I can satisfy milk quality specifications | |

| Construct | Indicator label | Statements used for each indicator (One statement per indicator) | Literature used for indicator development |
|---|---|---|---|
| **PFR** Processor-farmer relationship | Sat1 | I am satisfied with the price I am paid by my milk-processor | De Silva et al. (2023), Lees *et al.* (2020), Moses *et al.* (2023) |
| | Sat2 | I am satisfied with the net return I receive from supplying milk to my milk-processor | |
| | Sat3 | I am satisfied with the frequency of two-way communication I am having with my milk-processor | |
| | Tst1 | My milk processor provides honest information that is important to my business | |
| | Tst2 | My milk processor can be relied upon for assistance when needed | |
| | Tst3 | I like the values my milk processor upholds in business relationships with me. | |
| | Tst4 | I believe in my milk processor's proficiency in doing business with me | |
| | Comt1 | I feel committed to supplying milk to my milk processor for the next two years | |
| | Comt2 | I am willing to make changes to my farm business to better meet my processor's requirements | |
| | Comt3 | I am proud to be a supplier of my milk-processor | |
| **ES** Economic sustainability | EcnS1 | I am satisfied with the gross income received from dairy farming | De Silva et al. (2023), Lebacq *et al.* (2013), Zanin *et al.* (2020) |
| | EcnS2 | I am satisfied that the income I receive from farming meets my household needs | |
| **SS** Social sustainability | SocS1 | I am satisfied with the quality of life that has resulted from dairy farming | De Silva et al. (2023), Lebacq et al. (2013), Zanin et al. (2020) |
| | SocS2 | I am satisfied with the quality of education that my children receive | |
| | SocS3 | I am satisfied with the recognition I receive from the community due to interactive farming activities Consider the following, and provide an overall response: helping fellow farmers, sharing your resources etc. | |
| **EnvS** Environmental sustainability | EnvS1 | I do not have a formal system to dispose of the effluents (R) | De Silva et al. (2023), Zanin et al. (2020) |
| | EnvS2 | I use solid waste for agriculture activities (selling or giving free to fellow farmers is also acceptable) | |
| | EnvS3 | I do not have a specific plan to reduce air pollution (R). Consider the following, and provide an overall response: regular clearing of the cattle shed, composting manure and using covered storage facilities, adjusting feed rations to match the nutritional needs of cows, using easy-to-digest locally available feed crops | |

**Note:** (R) - reverse coded statements

# CHAPTER 6:
# EXPLORING DAIRY FARMER HETEROGENEITY IN A DEVELOPING COUNTRY TO IMPROVE FARMER PERFORMANCE THROUGH PROCESSOR-LED DEVELOPMENT PROGRAMS

This chapter has been submitted as a manuscript to the journal: Benchmarking: An International Journal. The manuscript is in the second round of its review process. Benchmarking: An International Journal (Publisher: Emerald, UK) is a double anonymous peer-reviewed journal. The website of the journal states that the journal is "the first journal to examine a business process design and improvement that is revolutionizing established practice and performance and is critical for companies committed to organizational performance based on measures/metrics, benchmarking and implementing the best practices".[20] The journal is classified as a Q1 journal in business, strategy, and management, with an impact factor of 4.5 in 2023 (with a 5-year impact factor of 4.80 in 2023), and is indexed by Scopus, CiteScore, SCImago.

Based on the theoretical and empirical insights gained in the previous chapter, particularly regarding the question, "Which constructs represent farmer performance?" this chapter uses the scores of these constructs (FC, PFR, ES, SS, and EnvS) to perform a cluster analysis to group farmers based on their performance. Having identified three reliably distinguishable performance clusters, the researcher characterizes the three clusters using a range of evaluation fields—including farmer development initiatives, farmer characteristics, and farm/production characteristics—to propose cluster-specific solutions for improving farmer performance. The theoretical, practical, and policy implications are also discussed.

[20] Benchmarking: An International Journal. (n.d.). Retrieved 02 January 2025 from https://www.emeraldgrouppublishing.com/journal/bij

**Abstract**

**Purpose** – To analyze the heterogenicity of dairy farmers in a developing country to explore how a milk processing firm could streamline its farmer development programs to elevate low-achieving farmers to high-achieving farmers within a specific context.

**Design/methodology/approach** – The data were collected from two dairy-intensive districts of Sri Lanka using a survey questionnaire administered to 324 dairy farmers enrolled in a processor-led farmer development program. Cluster analysis was used to group farmers based on their sustainable performance on six performance dimensions. Cluster characterization was conducted via a range of evaluation variables.

**Findings** – Farmer capability was the most influential performance dimension in segregating farmers into performance clusters. Three performance clusters were identified and named as laggers, accelerators, and leaders, based on the ascending order of performance. Compared to accelerators, laggers were significantly underperforming in all the performance dimensions considered. Low-achieving farmers were using intensive farming nearly always, but high-achieving farmers were using mostly semi-intensive or extensive farming, implying the need to change the existing farmer development program.

**Originality** – This study applies a multidisciplinary approach by integrating operations management, data science, and agriculture to address a specific agribusiness challenge in the dairy value chain of a developing country. The study is driven by a theory on performance improvement—based on the concept of supplier development—which makes performance improvement insightful. The study extends the use of supplier development conceptualizations for farmer development in an underexplored area in the literature.

**Keywords** Benchmarking, Developing countries, Farmer development, Sustainability

**Paper type** Research paper

## 6.1 Introduction

Agri-food supply chains (SCs) in developing countries are characterized by limited infrastructure, technology, and market access, as well as the use of traditional farming practices—all of which contribute to poor SC performance. Additionally, the prevalence of a high proportion of smallholder farmers—the weaker link of the SC—and a lack of government support further exacerbate poor SC performance (Habib et al., 2024; Khairallah et al., 2023; Rosairo & Potts, 2016). Given the pivotal role small and medium-scale farmers play in the rural life of developing countries—they contribute to household income, food security, poverty alleviation, economic empowerment of women, and social inclusion—developing the farmers to overcome poor performance remains a priority (Blackmore et al., 2022; Hidayati, Garnevska, & Childerhouse, 2023; Khairallah et al., 2023; Shingh et al., 2020). Implementing solutions to sub-optimal farmer performance can be greatly facilitated through group-focused solutions by systematically classifying farmers into distinct groups based on shared characteristics, behaviors, or practices (Bousbia et al., 2024; Hidayati et al., 2023; Kumar et al., 2019; Sinha et al., 2022; Wulandari et al., 2022).

The present study views farmer performance improvement from the angle of supplier development (SD). In the formative years, SD was defined as "any activity initiated by a buying organization to improve the performance of its suppliers"(Krause, 1999, p. 205). This initial thinking on SD has since been transformed into a more holistic concept known as sustainable supplier development (SSD) (Ağan et al., 2018; Bai & Satir, 2022; Boscari et al., 2024; Zanin et al., 2020). One of the main drivers behind the emergence of SSD is the pressure exerted by external stakeholders on businesses to manage their SCs in a way that not only ensures economic sustainability for the business itself but also promotes social and environmental sustainability across the business and its partners (Carter & Easton, 2011; Sánchez-Flores et al., 2020; Seuring & Müller, 2008). Bai and Satir (2022, p.1) defined SSD as “any initiative taken by the buying firms to improve their supplier sustainability capabilities to meet two or more elements of the triple bottom line (TBL) of multiple stakeholders along the supply chain (suppliers, buying firms, customers, etc.)". In a developing country, as the buying firm, there is an incentive for a milk processor to develop their milk suppliers, when these suppliers become farmers who supply milk directly (i.e., without using merchant intermediaries) (Mor et al., 2018), and there is low engagement from other parties (e.g., local government, dairy extension agencies, and nongovernmental agencies) who are expected to contribute towards farmer development (De Silva et al., 2023; Yawar & Seuring, 2018).

As is the case in many developing countries, Sri Lanka, the country in which the present study was conducted, agriculture serves as the primary source of livelihood for a significant portion of the population (Hidayati et al., 2023; Rosairo & Potts, 2016). The agriculture sector accounts for 26% of total employment in Sri Lanka, with rural employment predominantly reliant on agriculture and livestock. However, despite this significant employment contribution to the labor force, the sector itself contributes only 6.8% to the country's gross domestic product (GDP) (Central Bank of Sri Lanka, 2023). Only about 40% of fresh milk demand in the country is met by local dairy farmers; the balance is imported (Damunupola et al., 2022; Vidanarachchi et al., 2019). Smallholder dairy farmers produce approximately 75% of the 522 million liters of cow's milk (i.e. 392 million liters approx.) annually in the country (Damunupola et al., 2022; Jayasena et al., 2020). Of the 122,975 dairy farmers in Sri Lanka, 106,286 (85%) are smallholders (Department of Census and Statistics Sri Lanka, 2023). The per-farmer milk production volume among Sri Lankan dairy farmers is low, and significant improvements are needed in their productivity (e.g., increase the milk yield per cow) (Sullivan, 2020; Vyas et al., 2020).

In keeping with the classification used by Sri Lanka's statistics gatekeeper, the Department of Census and Statistics, this study identifies farmers owing less than 10 cows as smallholders, and farmers owing between 10-50 cows as medium-scale farmers (Department of Census and Statistics Sri Lanka, 2023). It is noted that less than 10 cattle threshold is commonly being used in the literature to distinguish smallholder dairy farmers from medium-scale farmers (Opio, 2017; Vidanarachchi et al., 2019), but the upper bound threshold to demarcate a medium-scale farmer from a large-scale farmer/farm business could be context-specific, according to the Food and Agriculture Organization of the United Nations (FAO) (FAO, 2018).

Although milk processor-led farmer development has been reported in a few studies (e.g., Brix-Asala et al., 2021; Yawar & Kauppi, 2018), there is insufficient empirical evidence to explain how farmers in a developing country can be meaningfully grouped based on their performance (e.g. low, medium, high) for a milk processor to execute tailored interventions efficiently (i.e. specific programs for specific farmer groups). The purpose of the present study is to bridge this knowledge gap.

The importance of this study is threefold. First, the study bridges theoretical insights and practical needs by integrating SSD into agriculture, addressing sustainable performance improvement through tailored interventions. Secondly, the study applies operations management theory on SD to agri-food to view farmer development from a different angle: processor-led farmer development. Finally, the study provides actionable frameworks for milk processors, emphasizing differentiated training and benchmarking best practices depending on the group to which a farmer belongs.

The remainder of the paper is structured as follows: Section 6.2 provides a review of the relevant literature. Section 6.3 covers the methodology and the associated methods and techniques. Section 6.4 presents the results, while Section 6.5 presents the discussion of the results highlighting implications to theory, practice, and policy. Finally, Section 6.6 concludes the paper by presenting a summary of key findings along with limitations and suggestions for further research.

## 6.2 Literature review

Since the study uses farmer performance as the basis for grouping farmers into typologies, the concept of processor-led farmer development—a term coined by the authors to distinguish development initiatives led by processors from those led by other stakeholders—is first conceptualized through a literature synthesis.

### 6.2.1 Conceptualization of processor-led farmer development

The concept of processor-led farmer development, or more generally, buyer-initiated farmer development can be considered to be a natural extension of the concept SD when applied to agri-food SCs (Brix-Asala et al., 2021; De Silva et al., 2023; Mukucha & Chari, 2021). The definitions of SD (Krause, 1999) or SSD (Bai & Satir, 2022) mentioned earlier are broad, and can be extended to agri-food SCs in which the farmer remains the supplier. The limited number of agri-food literature on SD (e.g., Brix-Asala et al., 2021; De Silva et al., 2023; Mukucha & Chari, 2021; Yawar & Kauppi, 2018) confirms this.

In operations management literature it is argued that SD would take place through buyer's direct initiatives (e.g., training, financial and technological investment, and knowledge transfer) and/or indirect initiatives (e.g. higher volume and/or long-term supply contracts, and supplier certification) to improve supplier performance—both forms of initiatives posited to benefit the buyer in sustaining its competitive position (Benton et al., 2020; Yawar & Seuring, 2020). In the literature, the causal link between the SD initiatives (direct or indirect) and *supplier performance* is sometimes hypothesized as direct and sometimes as indirect—for example, being mediated by the buyer-supplier relationship—depending on the theoretical lens being used in hypothesizing the relations (e.g., Benton et al., 2020; Krause et al., 2007; Wagner, 2009). More complex mediation paths between SD initiatives and supplier performance have also been hypothesized (e.g., Yawar & Seuring, 2020). In these studies, supplier performance has generally been operationalized as a concept that manifests as *product quality and delivery performance.* Some studies, however, have also considered additional (author-chosen) manifestations of supplier performance such as the price of the offer, responsiveness to changes in the supply conditions, and supplier service quality have also been considered (Benton et al., 2020; Wagner, 2009; Yawar & Seuring, 2017, 2020). What is generally lacking in the literature is extending the rationale of SD beyond the above-mentioned manifestations of supplier performance to explain the achievement of supplier's TBL outcomes (i.e. explaining SSD more holistically).

Agri-food studies explaining the relationship between farmer development and farmer performance are reviewed to justify the conceptualization used in the present study. Mukucha and Chari (2021) found empirical support for their overall hypothesis that contract tobacco farmers outperform regular tobacco farmers on farmer cost performance, quality performance, and delivery performance (context: Zimbabwe). The presumption is that the buyers (vendors) provide financial support and a range of farm extension services to contract farmers—a benefit that regular farmers do not receive, according to the authors. Yawar and Kauppi (2018) used case studies to demonstrate that milk processor-led smallholder farmer development programs improve farmer capability as well as the economic and social performance of the farmers, at the same time, improving the operational performance of milk processors (context: India). Brix-Asala et al. (2021) used case studies to demonstrate that the inclusion of base-of-the-pyramid (BOP) farmers (i.e., subsistence farmers) into SCs through SD programs (direct or indirect SD) is not a straightforward win-win situation as Yawar and Kauppi (2018) demonstrated. It can be argued that since BOP farmers are subsistence farmers, their potential to improve performance (e.g., increased milk yield and quality) is very limited, hence the above finding. De Silva et al. (2023) developed a theoretical framework consisting of five propositions that collectively state that both direct and indirect farmer development initiatives improve the economic, social, and environmental performance of farmers due to the mediating (intervening) role being played by farmer capability and farmer-processor relationship. The study of De Silva et al. (2023) provides a reasonable platform for exploring dairy farmer heterogeneity to device processor-led development programs to suit specific farmer groups.

### 6.2.2 Farmer typology analysis

Typology analysis refers to systematically assigning entities (e.g., in agriculture–farmers, farms, farmer behavior) into types (groups) based on shared characteristics to investigate how these types (groups) differ from one another. Agriculture typology analyses including farmer typology analyses are conducted to formulate agricultural policies or targeted interventions (Bartkowski et al., 2022; Huber et al., 2024; Kumar et al., 2019). The formation of groups would be done in such a manner that variability within a group would be low (i.e. entities within a group would show relative homogeneity) but the variability between the groups would be high (i.e. heterogeneity across groups). When entities are systematically grouped, the discussions about issues, interventions, and agricultural policy action on farmers/farms can be based on the characteristics of a group rather than on the characteristics of individual farmers/farms. Also, systematic grouping reduces the risk of leading to the adoption of one-size-fits-all policies, and interventions, which are unlikely to address the core issues peculiar to a specific group (Bánkuti et al., 2020; Bartkowski et al., 2022; Graskemper et al., 2021; Hidayati et al., 2023). The purposes of conducting a farmer typology study in a developing economy could be to identify and characterize diverse farmer/farm types, understand constraints and challenges in farming systems, and/or assess the impact of external factors on farming practices for targeted intervention (Bánkuti et al., 2020; Defante et al., 2019; Haileslassie et al., 2015; Kumar et al., 2019; Otieno et al., 2021).

Classical farmer typology analysis remains a multivariate problem for two main reasons. First, the numerous variables underpinning a given phenomenon (e.g., TBL sustainability) must be reduced in dimensionality to minimize noise, and redundancy (overlapping variables) to improve the overall quality of the groups (step 1) before forming groups using the reduced number of variables (Haileslassie et al., 2015; Otieno et al., 2021; Sinha et al., 2022). Second, grouping entities based on multiple variables (step 2) inherently presents a multivariate challenge. A review of the literature related to sustainable farming and developing counties (see Table 6.1 for a summary of six studies) reveals that principal components analysis (PCA) is typically used in step 1 and cluster analysis is typically used in step 2.

**Table 6.1 A summary table of relevant past studies on farmer typology analysis related to the topic ‘sustainability’ in developing countries**

| Author, context, and study purpose | Variables used for forming groups, sample size, and the methods used | Additional variables used in evaluating the groups | Key findings |
|---|---|---|---|
| Bánkuti et al. (2020); Context: Brazilian small, medium, and large-scale dairy farming.<br><br>Purpose: to study farmers’ actions towards achieving TBL sustainability | 13 sustainability variables were dimensionally reduced to 3 sustainability factors (labeled Economic, Social, and Environmental Sustainability)<br><br>Dimensional reduction method: PCA<br><br>Sample size: 75 dairy farmers<br><br>Clustering method: hierarchical clustering; 3 groups/clusters emerged | Farm size, daily milk production, number of cows, number of cows in milk production, milk production per cow per day, and annual milk production per farm area | The three levels of sustainability differed primarily in economic sustainability (Group 1 > Group 2 > Group 3) and environmental sustainability (Group 1 = Group 2, both > Group 3).<br><br>Group 1 farmers were identified as large-scale farmers, Group 2 as medium-scale farmers, and Group 3 as small-scale farmers. It was argued that Group 1 had the highest propensity for achieving TBL sustainability. |
| Hidayati et al. (2023); Context: Indonesian smallholder cashew farming.<br><br>Purpose: to study smallholders’ practices towards SC sustainability. | 40 variables covering sustainable SC practices of smallholder farmers were dimensionally reduced to 8 factors.<br><br>Dimensional reduction method: PCA<br><br>Sample size: 159 smallholder cashew farmers<br><br>Clustering method: two-step clustering; 4 groups/clusters emerged | Socio-economic characteristics consisting of farmer characteristics (5 variables), farm characteristics (3 variables), and several SC practices related to production (4 variables), marketing (8 variables), and quality certification and collaboration (2 variables) | The group labeled “accelerator” was found to perform well on both socio-economic characteristics and SC practices, while the group labeled “conservative” performed poorly on both. The remaining two groups performed well on only one of the two. |
| Defante et al. (2019) Context: Dairy businesses in Brazil<br><br>Purpose: to compare two farm business typologies: dairy farm businesses that comply with Brazilian quality standards (group 1) vs. the ones that do not comply (group 2). | 18 variables (15 economic and 3 social) were dimensionally reduced to two performance factors via PCA and were labeled “production scale and bargaining power” and “autonomy and production control. However, the two groups were author-defined.<br><br>Same size: 128 dairy farm businesses (8 in group 1 and 120 in group 2)<br><br>Mean herd size of group 1 = 29; mean herd size of group 2 = 21 | None/Note applicable | Group 1 outperformed Group 2 on both performance dimensions, implicating the importance of meeting national quality standards. |

| Author, context, and study purpose | Variables used for forming groups, sample size, and the methods used | Additional variables used in evaluating the groups | Key findings |
|---|---|---|---|
| Haileslassie et al. (2015);<br><br>Context: Indian dryland farming systems<br><br>Purpose: to study TBL sustainability differences arising from heterogeneous dryland farm systems. | 34 livelihood indicators—human, social, financial, physical, and natural—were dimensionally reduced to 13 factors.<br><br>Dimensional reduction method: PCA<br><br>Sample size: 500 farmers<br><br>Clustering method: hierarchical clustering; 5 groups emerged<br><br>The sustainability level of each group was assessed upon operationalizing economic, social, and environmental sustainability dimensions as composite variables consisting of multiple indicators. | Farm structural characteristics (12 variables) and farm functional characteristics (11 variables) | For all give groups economic sustainability was significantly lower than social and environmental sustainability. Moreover, more than 90% of farmers were found to be below the threshold for economic sustainability. |
| Sinha et al. (2022) Context: subsistence smallholders in Tribal villages in a particular state of India<br><br>Purpose: to identify the farm typology for target extension interventions | 21 socio-economic, biophysical, and geospatial variables were dimensionally reduced to 6 factors.<br><br>Dimensional reduction method- PCA<br><br>Sample size: 394 farmer households<br><br>Clustering method: K-means clustering; 4 groups emerged | No additional evaluating variables were used. | Four groups identified via cluster analysis were qualitatively validated to make the quantitative analysis more valuable for farm extension service providers |
| Otieno et al. (2021) Context: smallholder dairy farmers in Kenya<br><br>Purpose: to identify smallholder dairy farming typologies and their determinants | 40 variables on the milk output, land use, household income, physical infrastructure, etc. were dimensionally reduced to four factors.<br><br>Dimensional reduction method: PCA<br><br>Sample: 380 farmers<br><br>Clustering method: hierarchical and K-means clustering: 3 groups emerged | In each group, 22 household characteristics were analyzed | The main determinants of smallholder dairy farming typologies were identified as a land factor, years of dairy farming, stock of dairy animals kept, labor engaged, household income, farming assets, dairy output and consumption level, and costs of production |

The following observations can be made from the six studies summarized in Table 6.1: (i) the types of variables used in step 1 (before and after dimensionality reduction) within the broader topic of 'sustainable farming' are highly context-specific; (ii) often, additional variables are investigated (for each group) to fully characterize the typologies; and (iii) typology studies primarily focus on classification and characterization rather than proposing interventions to improve the performance of entities (i.e., the theory of improvement is not strongly emphasized).

### 6.2.3 Insights from benchmarking as an improvement approach

Benchmarking is a widely accepted approach aimed at performance interventions, which is fundamental to the continuous improvement of operational performance and competitiveness of a business (Mahato et al., 2023; Moffett et al., 2008; Moriarty & Smallman, 2009). It is unsurprising that benchmarking has found its place in the agri-food industry (Jack, 2012; Mulkerrins et al., 2023; Yakovleva et al., 2012). For the present study, benchmarking is defined as a process that examines what areas to improve and learn from others (e.g. exemplar organizations) to improve their operational and business performance (Moriarty & Smallman, 2009). Although benchmarking studies can take the form of process benchmarking (focusing on specific business processes), functional benchmarking (comparing processes across different business functions), or performance benchmarking (comparing performance outcomes between two or more businesses) (Bogetoft, 2012; Horváthová et al., 2021), the present study focuses exclusively on performance benchmarking in the context of farmers in developing countries, as it aims to measure and group farmers based on performance.

Kahan (2013) of the FAO provided a ten-step guide to benchmark farm businesses of developing countries to improve performance: organizing benchmarking groups, identifying what needs to be examined (i.e., performance areas), identifying the relevant key performance indicators (KPIs), identifying the farms included in benchmarking, collecting data, comparing performance, interpreting the differences, sharing the results/findings, designing the interventions, and evaluating the outcomes. Yadava and Komaraiah (2021) employed data envelopment analysis (DEA) to benchmark the performance of organic farm businesses across 21 Indian states. Their study was aimed at determining the potential for improving the current technical efficiency of farms across all states, and to identify the states with relatively higher performance levels. Mareth et al. (2019) employed DEA to benchmark the technical efficiency of dairy farmers in South Brazil. They considered four determinants of dairy farmer efficiency:

farmer education (not found to be statistically significant), farm size, feed and labor costs, and use of services. Mor et al. (2018) benchmarked the Indian dairy SC and found that the information sharing system, milk waste management, shipping responsiveness, and brand management were the most important KPIs for the businesses in the SC that they reviewed. Suttapong and Tian (2012) highlighted the importance of benchmarking using non-financial performance areas such as quality performance and societal impact. Uddin et al. (2012) identified dairy support services, market access, veterinary services, feed and nutritional services, and community-based fodder production activities as dairy-specific performance areas that need to be used for benchmarking.

In concluding the literature review, it is noted that agrifood studies on processor-led—or more generally, buyer-initiated—farmer development (section 6.2.1) is foundational, but require deeper theoretical insights offering efficient ways of developing farmers to improve their performance. A review of farmer typology studies (section 6.2.2) highlights various ways of grouping farmers and creating typologies within agribusiness literature, which largely lacks focus on processor-led farmer development. Additionally, a review of benchmarking studies applied to agriculture (section 6.2.3) demonstrates how benchmarking can be incorporated into farmer development. However, no published studies integrate these three subdomains to offer a more holistic and efficient approach to processor-led farmer development. This study aims to address this knowledge gap.

## 6.3 Methodology

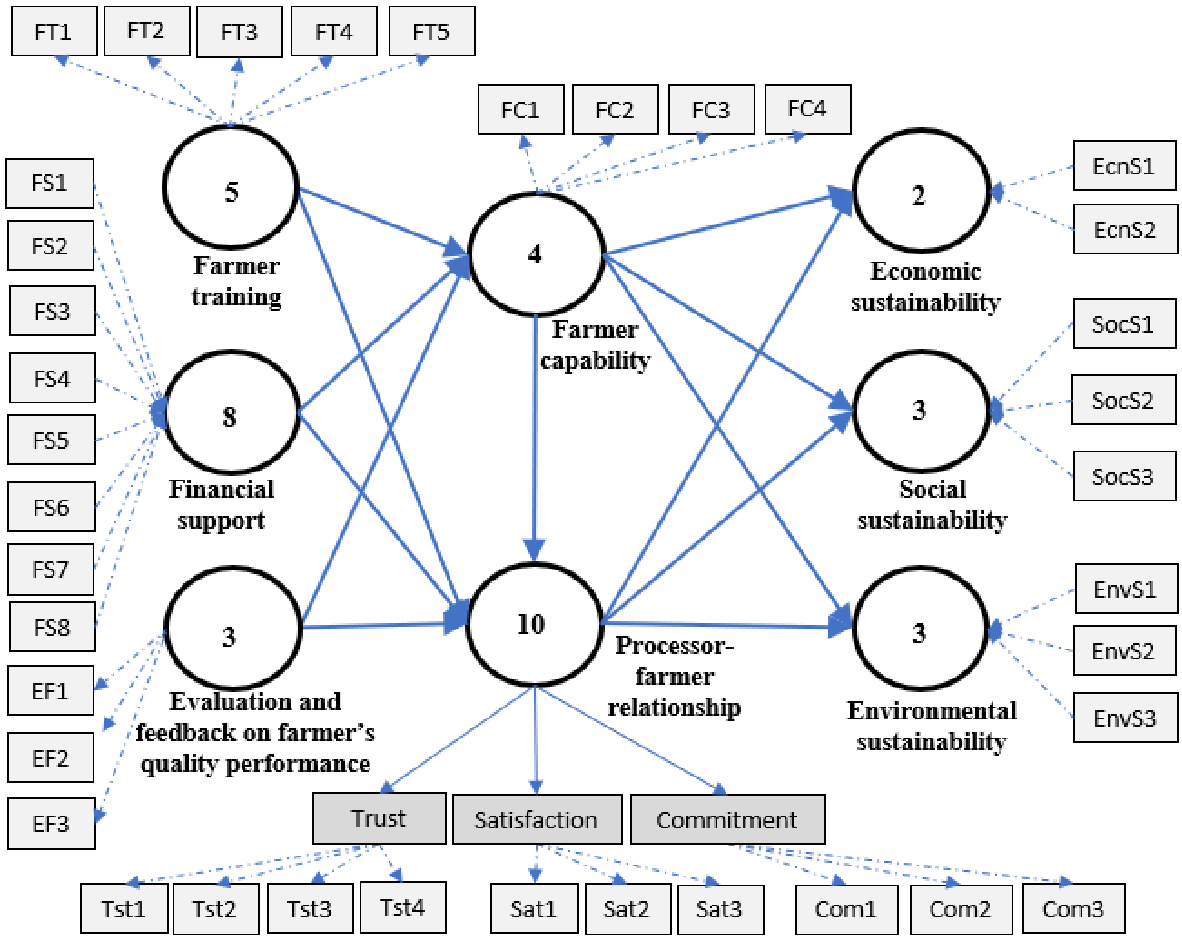
### 6.3.1 The theoretical framework on processor-led farmer development

The theoretical framework of De Silva et al. (2023) was further developed to become a testable theoretical model (Figure 6.1) by the present authors. While details of the development of the theoretical model and its validation using data collected through a questionnaire is beyond the scope of this study, the authors would like to mention that the questionnaire and data used for model validation were identical to those employed in the present study. Further, partial least squares structural equation modeling technique (Hair et al., 2019) was used to test the theoretical model. The test results confirmed that the constructs shown in the theoretical model are reliable and valid.

To group farmers based on their sustainable performance, the present study uses five constructs (factors) on farmer performance, which are explained as follows: *Farmer capability* is operationalized as the ability of the farmer to apply the knowledge acquired from formal training (FC1), maintain relationships with extension service providers (FC2), deliver milk quantity requirement the processor expects (FC3), and maintain milk quality specifications of the processor (FC4) (De Silva et al., 2023; Nath et al., 2010; Sachitra & Chong, 2018). *Processor-farmer relationship* is operationalized as the collaborative relationship between the two parties, which is manifested as Trust (Tst1-Tst4), Satisfaction (Sat1-Sat3), and Commitment (Com1-Com3) (De Silva et al., 2023; Lees et al., 2020; Moses et al., 2023). *Economic sustainability* is operationalized as an index covering three areas: farmer satisfaction on the gross income received (EcnS1), farmer satisfaction on income being able to meet household needs (EcnS2), farmer satisfaction on the profitability of the farm business (EcnS3) (De Silva et al., 2023; Lebacq et al., 2013; Zanin et al., 2020). *Social sustainability* is operationalized as an index covering three areas: farmer satisfaction with the quality of life of the family (SocS1), farmer satisfaction on access to education of the children (SocS2), and farmer satisfaction on community recognition through interactive farming activities (SocS3) (De Silva et al., 2023; Lebacq et al., 2013; Zanin et al., 2020). Finally, *Environmental sustainability* is operationalized as an index covering three environment-friendly farming practices: effluent disposal (EnvS1), solid waste use (EnvS2), and reducing air pollution (EnvS3) (De Silva et al., 2023; Lebacq et al., 2013; Zanin et al., 2020).

The three constructs representing processor-led farmer development initiatives—*farmer training*, *financial support,* and *'evaluation and feedback on farmer's quality performance'*—were considered as additional evaluating variables as they are not performance variables forming the clusters. Farmer training is operationalized as farmer training and education provided by the milk processor reflecting five areas (FT1-FT5) (Brix-Asala et al., 2021; De Silva et al., 2023; Yawar & Seuring, 2020). Financial support is operationalized as an index covering eight types of financial support (FS1-FS8) (FT1-FT5) (Brix-Asala et al., 2021; Chopde et al., 2019; De Silva et al., 2023). Evaluation and feedback on farmer's quality performance is operationalized as a construct reflecting three areas (EF1-EF3) (Brix-Asala et al., 2021; De Silva et al., 2023; Pedroso et al., 2021; Yawar & Seuring, 2020). See Figure 6.1 and Chapter 6, Appendix 1 for the positioning of the operationalizations.

The above operationalization means that within a framework of classical farmer typology analysis (section 6.2.2), step 1 of dimension reduction for cluster analysis has taken place via a confirmatory approach, as opposed to the traditional exploratory approach via PCA. From the indicator labels shown in Chapter 6, Appendix 1, the reader will note that farmer capability is indeed a supplier performance dimension as its final two indicators (FC3 and FC4) cover the supplier performance variables delivery performance and product quality respectively; as mentioned earlier, these performances are the mandatory fields of supplier performance. As with farmer capability, the processor-farmer relationship has also been regarded as a farmer performance dimension leading to sustainable farmer performance (i.e., TBL outcomes of the farmer).




**Notes:** Figures within the circles (constructs) show the number of indicator variables belonging to each of them. The construct of Economic sustainability had one more indicator (EcnS3), but it was rejected at the stage of model validation (also see Appendix 1). Hence out of the 39 indicator variables considered, 38 were used for the present study.

**Figure 6.1 The theoretical model used to conceptualize processor-led farmer development**

*(Source: Own work)*

### 6.3.2 Designing the data collection instrument

The survey questionnaire consisted of two parts. Section A of the questionnaire consisted of 39 indicator variables that capture the eight constructs shown in the conceptual model. Each indicator variable was presented as a statement for which the agreement was sought on a five-point Likert-type scale. Some statements in the questionnaire were reverse coded (R) to reduce response bias, ensure attentiveness, and detect careless responses but have been handled with caution in the analysis (Suárez Álvarez et al., 2018). Section B of the questionnaire consisted of questions to capture the additional evaluation variables (see Table 6.3) required for conducting the typology analysis. The following three steps were conducted before the formal administration of the survey. Firstly, the original questionnaire (the English version) was pretested by four experts (two experienced academics and two experienced practitioners) to verify the clarity and relevance of the contents (i.e., establishing face validity). Secondly, the English version was translated into Sinhala language and Tamil language (the farmers' native languages) by two experienced translators and these translated versions were back translated to English again by two different experienced translators. This is to verify the accuracy of the translations (the first author did this verification) (Fowler Jr, 2013). Finally, a pilot test was conducted with 30 randomly selected farmers to test the questionnaire (e.g., to know whether they were competent in responding to the questionnaire with minimal help from the research assistant who presented the questionnaire, to test whether unusual patterns of responses emerge) before full-scale administration (Fowler Jr, 2013).

### 6.3.3 Questionnaire administration

Sri Lanka was selected as the study context because of the demonstrable evidence of processor-led dairy farmer development. Eligible farmers of one of the largest privately owned milk processing companies were included in this study because this company has clear threshold criteria for inclusion in their farmer training program—farmers who consistently supply $\geq 20l$ of milk/day on average and/or own $\geq 5$ milk-producing cows—and uses its large contingent of extension officers to train the farmers included their training register (the ones who pass the threshold criteria); relative to their counterparts not included in the training register, the ones in the register receive more financial support to improve their business and also receive more feedback on their quality performance via the extension officers and milk collection centers of the company. An advantage the milk-processing company has over its competitors is the former owning a bank which specializes in agriculture financing. In addition, the company operates in all major milk production districts of Sri Lanka, including Nuwara Eliya (the district that produces the highest volume of milk) and Kurunegala (the district that produces the second highest volume of milk), which were the two districts covered in the data collection. While selecting a single milk processor to fit the theory on processor-led farmer development is an advantage, it also suffers from the disadvantage of exclusion of farmers who are either not being trained, trained minimally, or trained differently by other milk processors.

The farmers in the two districts included in the study can generally be distinguished from one another based on the cow breeds and farming methods being used. Nuwara Eliya has a cooler climate similar to that of Spring in England; this climate is suitable for raising exotic cow breads such as Jersey and Holstein-Friesian, which are high-milk-yielding breads (Hitihamu et al., 2021). Kurunegala has a hot and humid climate that suits local and local-Indian cross breads that are robust (can withstand the climate), and less expensive, but produce much lower milk yields, partly limited by the genetics (Hitihamu et al., 2021). However, due to terrain and limited access to grassland, Nuwara Eliya farmers adopt intensive farming (e.g., heavy use of commercially available energy-dense animal feed) whereas Kurunegala farmers have the greater flexibility of using either extensive farming (e.g. when abundance of natural forage is available for cattle, which is often the case) or a mix of both extensive and intensive (i.e. semi-intensive) farming (Hitihamu et al., 2021; Vidanarachchi et al., 2019). This contrast resulting from the specific geography of Sri Lanka and land availability may not be generalizable across developing countries (how it affects the generalizability of the findings is covered in the conclusion).

Of the 15,858 farmers (nationwide) that supply milk to the company, 1205 belonged to Nuwara Eliya, of whom 772 (64%) were included in the milk company's training register (i.e. ones that passed the eligibility criteria for training). Similarly, of the 3,172 farmers who belonged to Kurunegala, 792 (25%) were included in the milk company's training register. The overall number of 772 plus 792 farmers undergoing training in the two districts was further reduced to 400 via random section, selecting one farmer at a time from each district, to contact the farmers (via mobile phones) to obtain their consent to collect data via a questionnaire by visiting their farms (four research assistants were deployed for field visits and data collection). Of the 400 farmers contacted (200 from Nuwara Eliya and 200 from Kurunegala), 324 consented to participate of whom 155 were from Nuwara Eliya and 169 were from Kurunegala. Of the 155 Nuwara Eliya farmers, 138 were smallholder farmers (<10 cows) and 17 were medium-scale farmers (10-50 cows). Similarly, of the 169 Kurunegala farmers, 89 were smallholder farmers and 80 were medium-scale farmers (10-50 cows). This shows that there is a disproportionately higher number of medium-scale farmers in Kurunegala district undergoing the farmer training program implemented by the milk processor. This can be justified on the grounds that per-cow milk production in Kurunegala is low than that in Nuwara Eliya due to type of cows being used (hence Kurunegala farmers needing more cows to meet the milk volume threshold to include in the training program).

Although the World Bank defines smallholder farmers as those who work on a plot of land less than 1 hectare (2.5 acres) area, this norm was not used in the present study because land area is not a good factor of dairy milk production (compared to labor and capital) for dairy farmers engaged in intensive dairy farming in Sri Lanka (most farmers in Nuwara Eliya). Another reason why the land area was not used in distinguishing smallholder dairy farmers from medium-scale farmers was that some smallholder farmers did not have verifiable information (e.g. their property boundaries) to justify the usable land area indicated by them. Thus, although the land area was recorded in the survey, it was not used as a criterion to identify smallholder farmers. Consequently, as mentioned in the introduction, farmers owning <10 milk-yielding cows were categorized as small-scale farmers, while those owning 10-50 cows were categorized as medium-scale farmers (Department of Census and Statistics Sri Lanka, 2023; FAO, 2018; Opio, 2017; Vidanarachchi et al., 2019). However, the upper limit of medium-scale farmers was reduced to 40 cows as there were no cases found in the sample >40 cows.

### 6.3.4 The data analytic approach

Missing data (0.01%) were imputed using the 'mean replacement' method. Reverse-coded items were specifically marked, and each reverse-coded item was reverse-scored so that higher values represented stronger agreement, aligning them with the interpretation of other items in the scale. Response bias was excluded by matching the farmers in the two sub-samples (the Nuwara Eliya sample and the Kurunegala sample) with those in the training register (for the two districts) using herd size as the farmer characteristic used for matching the two sub-samples.

As mentioned earlier (section 6.3.1), five constructs—farmer capability, processor-farmer relationship, farmer's economic sustainability, social sustainability, and environmental sustainability—were used to group farmers based on their performance. Thus, the five constructs (factors) became cluster variables in the cluster analysis that created the groups (clusters). Before cluster analysis, multicollinearity among the above five constructs was excluded by examining the variance inflation factor (VIF) figures of the five constructs, which were all well below the 5.0 threshold (see Chapter 6, Appendix 1) for multicollinearity (Hair et al., 2014). Since all five cluster variables were performance dimensions, the hypothesis was that the groups that would emerge from cluster analysis would show a performance hierarchy, in termers of mean scores of cluster variables; one-way analysis of variance (ANOVA) was used to test this hypothesis.

Regarding the clustering algorithm, the two-step clustering (pre-clustering followed by clustering) incorporated in IBM SPSS software (version 29) was used, as it uses an objective optimization criterion to determine the optimum cluster solution. Also, SPSS reports the Silhouette measure as a criterion to suggest the quality of the clustering criterion (Tkaczynski, 2017). The results obtained via hierarchical clustering (a two-cluster solution or a three-cluster solution seemed acceptable) followed by K-Means clustering provided similar results.

Once the clusters were formed, the mean values of the three farmer development initiatives, two farmer characteristics, and eight farm/production characteristics were evaluated (Table 6.3) to fully characterize the farmer typologies (the farmer groups) and to make conclusions, including recommendations to make farmer development more efficient and effective.

## 6.4 Results

### 6.4.1 Optimal number of farmer performance clusters

Although two-step clustering based on the default/automatic optimization criterion in IBM SPSS (Bayesian information criterion) suggested that a two-cluster criterion is optimal, a three-cluster solution was manually selected as the reported Silhouette measure of 0.50 did not drop to a noticeable level when the cluster numbers were increased from a two to three. A Silhouette measure >0.5 suggests good cluster separation; a value between 0.2-0.5 suggests satisfactory cluster separation, while a value <0.2 suggests poor cluster separation (Rousseeuw, 1987). Cluster 1 comprised 136 farmers (42%), cluster 2 also comprised 136 farmers (42%), while cluster 3 comprised 52 (16%) farmers. A three-cluster solution as opposed to a two-cluster solution enabled the performance to be grouped at three levels (e.g., low-medium-high) as opposed to two levels (e.g., low-high), to make the clustering.

### 6.4.2 Naming the clusters

Table 6.2 shows the mean scores of the cluster variables. The rows in Table 6.2 are arranged according to the descending order of importance of cluster variables, as determined by the software. The software considers the contribution each cluster variable makes in providing maximal cluster separation (more precisely, minimum within-cluster variation and maximum between-cluster variation). Thus, farmer capability and farmer-processor relationship are the two variables that contribute most towards performance differences between the clusters.

Results in Table 6.2 indicate that farmers in Cluster 2 perform significantly better than those in Cluster 1 but not as well as those in Cluster 3 across all five cluster (performance) variables. In addition, the increase of mean values of performance variables from cluster 1 to cluster 2 is steep (e.g., farmer capability increases from 2.19 to 3.91, which is a 34.5% increase), but the increase of mean values from cluster 2 to cluster 3 is less steep (e.g., farmer capability increases from 3.91 to 4.54, which is just a 16.1% increase). Given that 1 is the lowest possible value and 5 is the highest possible value we can expect in the five-point scale being used, farmers in clusters 1, 2, and 3 were labeled laggers, accelerators, and leaders respectively.

**Table 6.2 Descriptive statistics of cluster variables in the three clusters**

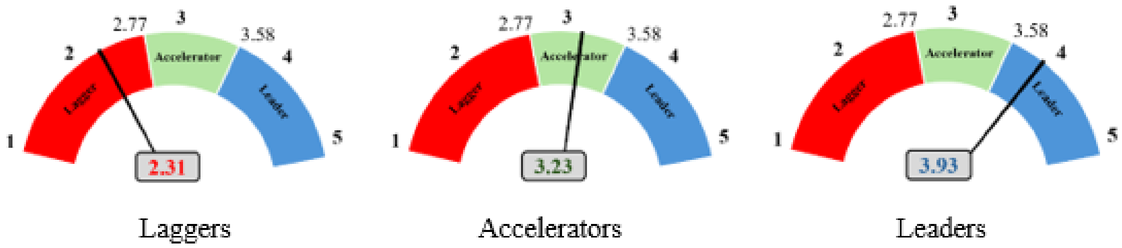
| Cluster Variable [Percentage Importance] | Cluster 1 (136 farmers; 42%) Label: Laggers | | Cluster 2 (136 farmers; 42%) Label: Accelerators | | Cluster 3 (52 farmers; 16%) Label: Leaders | |
|---|---|---|---|---|---|---|
| | Mean±StDev | Min~Max | Mean±StDev | Min~Max | Mean±StDev | Min~Max |
| Farmer capability [100%] | 2.19±0.67 | 1.00~4.52 | 3.91±0.53 | 1.87~3.91 | 4.54±0.57 | 1.93~5.00 |
| Farmer-processor relationship [69%] | 2.89±0.56 | 1.30~4.30 | 3.75±0.42 | 1.70~3.75 | 4.43±0.38 | 3.59~5.00 |
| Economic sustainability [55%] | 2.07±0.92 | 1.00~4.36 | 3.36±0.79 | 1.36~3.36 | 4.34±0.67 | 2.44~5.00 |
| Environmental sustainability [55%] | 3.19±0.79 | 1.01~4.68 | 4.22±0.46 | 3.22~4.22 | 4.80±0.42 | 3.24~5.00 |
| Social sustainability [42%] | 3.36±0.74 | 1.63~5.00 | 3.94±0.43 | 2.58~3.95 | 4.72±0.31 | 3.80~5.00 |
| Overall performance | Mean =2.31 (StDev = 0.326)<br>Worst Performer's Score =1.34<br>Best Performer's Score =3.03 | | Mean =3.23 (StDev = 0.177)<br>Worst Performer's Score =2.71<br>Best Performer's Score =3.64 | | Mean: 3.93 (StDev = 0.142)<br>Worst Performer's Score =3.57<br>Best Performer's Score =4.22 | |

The one-way ANOVA results (Chapter 6, Appendix 2) confirmed that the mean score differences between the three clusters, for all five cluster variables are statistically significant and that the

Leaders > Accelerators > Laggers hierarchy exists, as hypothesized. As the weakest, Laggers have been treated as the baseline for comparing the performance of the Accelerators and Leaders. The figures in Table 6.2 suggest that, compared to Accelerators, Laggers have considerable room for improvement, particularly in Economic sustainability and Farmer capability. The 'overall performance' metric (Table 6.2 and Figure 6.1), which has been calculated from the cluster variable data weighted by their % importance, provides a good picture of where the farmers in each cluster are and where they should be.

Thus, the key points to note from the results presented so far are as follows:

i. Farmer capability and the Processor-farmer relationship are the key variables influencing performance differences between farmer clusters. This is an important finding for the milk processor also, as their farmer development initiatives aim to enhance farmer capability (e.g. farmer's deliver performance and quality performance) and maintain mutually beneficial relationships.
ii. For Laggers, economic sustainability is the weakest outcome of farmer development. Their environmental sustainability outcomes are also poor.
iii. Laggers occupy a wide performance spectrum (clearer from the relatively high SD of overall performance) from being very poorly performing to moderately poor performing.
iv. The dashboard of overall performance (Figure 6.2), which is based on the data in Table 6.2, supports the cluster names by displaying pointer ranges similar to those on a vehicle speedometer. The results show that even leaders have room for improvement. The best performer in the sample secured only a score of 4.22, which is well below the 5.0 mark.




**Note**: the pointers are positioned at the respective cluster means for overall performance; the demarking point (e.g., 2.77 between Laggers and Accelerator) has been calculated by averaging the mean scores of neighboring clusters.

**Figure 6.2 A performance dashboard for the overall performance of each member in each cluster**
*(Source: Own work)*

Having examined the scores of the cluster variables in each cluster, the paper now examines the mean scores of important variables that were not used for cluster formation (i.e., the additional evaluation variables). The purpose of doing this is to profile the clusters in terms of the assistance the farmers receive from their processors to develop their farmer/farm characteristics, to better profile the three clusters.

### 6.4.3 Examination of the mean scores of the additional evaluation variables

From the mean scores of development initiatives shown in Table 6.3, it seems that the development support/s a farmer receives from their milk processor depends on the farmer's performance level (i.e., in general, Laggers receive the least support, and Leaders receive the most support), implying performance-based incentivization. These findings provide additional credibility to the theory implied in the conceptualization (Figure 6.1); for example, if the farmer capability score is high, one would expect the Farmer training score to be high.

The high cost of production associated with laggers (Eq. US$/L) is somewhat surprising because most of them (95.6%, as shown in Table 6.3) adopt intensive farming (and, justifiably based in Nuwara Eliya). Intensive farming relies on higher per-cow costs for production inputs (e.g., cow feed, veterinary services) and labor, but lower per-cow land use; this cost structure is reversed in extensive agriculture, mainly due to the utilization of a greater land area per cow and low labor cost (Gliessman, 2014; Morgan, 2009). In addition, intensive farming systems—if the cows can be raised in a favorable cold climate such as Nuwara Eliya—allow farmers in developing countries to raise high-yielding exotic cows that should offset the high per-cow expenses (Moran, 2012; Morgan, 2009), although this does not seem to be happening in the study context. These findings indicate that laggers need more assistance to improve their cost efficiency because their cost of production is phenomenally high relative to accelerators and leaders.

Results in Table 6.3 also show that there is a strong association between the two categorical variables 'farming system' being used (intensive/semi-intensive/extensive) and the 'farming region' (Nuwara Eliya/Kurunegala); Pearson chi-square =220.49, $df$=2, $p$<0.001; interestingly all the farmers in Nuwara Eliya seem to be adopting intensive farming while only few Kurunegala farmers seem to be adopting this farming method.

**Table 6.3 Mean scores of evaluation variables for cluster profiling**

| Variable | Cluster1 Laggers | Cluster2 Accelerators | Cluster3 Leaders | Accelerators > Laggers? | Leaders > Accelerators? |
|---|---|---|---|---|---|
| *Development initiatives* | | | | | |
| - Farmer training | 2.50 | 3.56 | 3.72 | Yes | No |
| - Financial support | 2.03 | 3.10 | 3.57 | Yes | Yes |
| - Evaluation and feedback | 2.07 | 3.59 | 4.02 | Yes | Yes |
| *Farmer characteristics* | | | | | |
| - Schooling (Years) | 7.86 | 10.29 | 10.92 | Yes | No |
| - Experience (Years) | 24.20 | 15.67 | 14.35 | No* | No |
| *Farm/production characteristics* | | | | | |
| - Heard size (cows) | 6 | 11 | 11 | Yes | No |
| - Quantity supplied (L/day) | 38.05 | 29.17 | 31.98 | No* | No |
| - Production (L/day) | 42.43 | 32.68 | 34.38 | No* | No |
| - Cost of production (Eq. US$/L) | 0.32 | 0.18 | 0.08 | No* | No* |
| - Payment received (Eq. US$/L) | 0.38 | 0.40 | 0.40 | Yes | No |
| - Production (L/cow/day) | 8.89 | 3.51 | 3.72 | No* | No |
| - No. (%) of farmers in the Nuwara Eliya district | 130 (95.6%) | 20 (14.7%) | 5 (9.6%) | N/A | N/A |
| - No. (%) of farmers in the Kurunegala district | 6 (4.4%) | 116 (85.3%) | 47 (90.4%) | N/A | N/A |
| - No. (%) of farmers engaging in intensive farming | 130 (95.6%) | 35 (25.9%) | 7 (13.5%) | N/A | N/A |
| - No. (%) of farmers engaging in semi-intensive farming | 3 (2.2%) | 52 (38.5%) | 19 (36.5%) | N/A | N/A |
| - No. (%) of farmers engaging in extensive farming | 3 (2.2%) | 48 (35.6%) | 26 (50%) | N/A | N/A |

**Notes:**

(a) * Inequality is reversed (e.g., Laggers>Accelerators)

(b) See Appendix 2 (one-way ANOVA test results) for the justification of Yes, NO entries shown in the last two columns

(c) N/A because one-way ANOVA does not apply when the dependent variable becomes a categorical variable (type of farming: intensive/semi-intensive/extensive; region: Kurunegala/Nuwara Eliya)

Despite poor cost efficiency, it is not surprising that laggers achieve a higher per-cow yield (8.89 L/cow/day) compared to accelerators (3.51 L/cow/day) and leaders (3.72 L/cow/day) as laggers, who are mostly from Nuwara Eliya are raising high milk-yielding exotic cows. For this reason, if one uses milk production/cow/day as a metric to evaluate/benchmark farmers across the three groups, the respective gross figures need to be normalized. Based on the composition of cow breeds and their milk yield potential, it was found that the expected yield for laggers should be about 20 L/cow/day (because most cows are exotic high-yielding cows if properly managed), and the expected yield for accelerators and leaders should be about 6 L/cow/day (because most farmers in these two group are from Kurunegala and they mainly raise indigenous, low milk yielding, easy-to-maintain cows). This normalizes mean milk production to 44% of target, 59% of target, and 62% of target for laggers, accelerators, and leaders, respectively. From an animal science standpoint, high milk-yielding cows need more energy-dense food and animal care. Farmers who use such cows for milking (in this study, the laggers in general) must acquire knowledge to know how to reduce operating costs without compromising cow maintenance.

Among other things, the ways in which laggers can be advanced to become accelerators, and eventually leaders, are discussed next.

## 6.5 Discussion

### 6.5.1 Theoretical contributions and implications

Most farmer/farm typology studies in agriculture (section 6.2) use an exploratory approach—PCA followed by cluster analysis—to identify farmer heterogenicity (Bartkowski et al., 2022). However, this study uses operations management theory on SD (processor-led farmer development) as the theoretical basis for clustering, which has not been used before in grouping farmers. Thus, instead of using factors/components via PCA for cluster formation, this study employs theoretically validated constructs as cluster variables to identify three farmer clusters. The clusters are based on a range of performance variables, which means that the clusters can be reliably distinguished from one another solely based on farmer performance, which makes processor-led farmer development more effective as various farmer development initiatives, as well as other evaluation variables, can be used to examine how these variables might be manipulated to optimize farmer development. Thus the novelty of the study design is that it uses a multidisciplinary approach combining SD theory in operations management (De Silva et al., 2023), continuous improvement via benchmarking, with agriculture literature and data science to optimize processor-led farmer development in developing economies. The three farmer clusters that emerged in this study (laggers, accelerators, and leaders) can also be reconciled with the 'diffusion of innovations' concept advanced by Rogers (1962)—although five groups have been conceptualized in this concept—in terms of innovation adoption, social and financial sustainability, adding more value to the study.

Existing theories on enhancing agricultural productivity and sustainability often focus on either economic or environmental sustainability, but not all three TBL dimensions as in this study. While accepting that economic sustainability is foundational for achieving environmental and social sustainability (Hidayati et al., 2023; Zanin et al., 2020), the present study also shows how one can look beyond economic sustainability to gain a deeper theoretical understanding of sustainable farmer development. More importantly, the study found that a farmer's TBL outcomes are commensurate with the degree of farmer development support the farmers receive from their processor bringing credibility to the conceptual model used in this study as well as the theory implied in the conceptualization of De Silva *et al.* (2023).

### 6.5.2 Practical contributions and implications

Foremost, it is reminded that all farmers covered in the study are farmers who are enrolled in the milk processor's training register; subsistence/BOP farmers do not receive any tangible farmer development support from the milk processor as they do not meet the eligibility criteria. For policymaking and designing farmer development initiatives tailored to suit a farmer cluster, it is important to determine to which cluster any chosen farmer belongs. The performance dashboard range shown in Figure 6.2 becomes a reliable way of assigning a farmer to the relevant cluster. In addition, the six cluster variables (the constituents of overall performance) can be used as KPIs for performance benchmarking purposes. Thus, the following practical steps are suggested to determine a farmer's cluster: (i) administering the questionnaire (Chapter 6, Appendix 1) to a farmer and obtaining the farmer's scores for the 38 items in the questionnaire; (ii) calculating the cluster variable scores from the weights given in Chapter 6, Appendix 1; (iii) determining the overall performance score using the % importance weights shown in Table 6.2. Alternatively, in the specific context of this study, the processor could adopt a simpler approach to transitioning Laggers into Accelerators. The performance gap among Laggers can be attributed to Nuwara Eliya farmers, who raise high milk-yielding but costly-to-maintain exotic cows under intensive farming practices.

The study showed that while accelerators and leaders perform better than their lagging counterparts in milk productivity (normalized L/cow/day), they also tend to underperform against targets/benchmarks. As shown in section 4, the normalized milk production of laggers, accelerators, and leaders is 44%, 59%, and 62% of the target, respectively. Most of the leaders, hail from Kurunegala, where indigenous cows are predominantly used for milking, but their cows, on average, produce only 3.72 L/day. This figure is not significantly different from the average output of an indigenous cow in India (Sri Lanka's neighbor). However, compared to Sri Lanka, Indian agriculture is now making more progress in crossbreeding to achieve yields that are about three times higher than those of their native cow varieties (Singh, 2016). It is recommended that benchmarking be introduced/facilitated by the milk processors in a suitable form (e.g. sharing success stories within and outside the country, especially Indian success cases).

The results (Table 6.3) showed that the cost of production of laggers is almost the same as the payment they receive for their net production (total production minus household consumption), which is a hopeless position to be in. This is also reflected in the economic sustainability scores of the clusters. The leaders secured an average mean of 4.34 for economic sustainability which means in the 5-point Likert scale being used, leaders tend to agree that they were satisfied with their economic sustainability. Laggers on the other hand secured only a mean score of 2.07, which means that they tend to disagree that they were satisfied with their economic sustainability (the accelerators tend to be in between given their mean score of 3.36. The root causes of performance improvement gaps of laggers, accelerators, and leaders are likely to be different, and the study prompts practitioners and other agents to tailor solutions that are best suited to each group. For example, a lack of formal education and resulting low emotional intelligence (Karia, 2021) could act as a barrier to laggers more than to leaders (Table 6.3) in applying what they learned from training, accessing or securing available financial support, and understanding quality performance feedback they receive from the milk processing company (Mareth et al., 2019). The conceptualization used in this study suggests that the economic sustainability of a farmer will not improve, unless farmer capability is improved (e.g., better delivery and quality performance), and farmer capability will not improve unless farmer training, financial support, farmer evaluation, and feedback is raised (Figure 6.1). As mentioned earlier, the results certainly supported this conceptualization. It is suggested that laggers need to be trained in ways that are different from accelerators and leaders.

The processor provides on-site training to farmers through their extension officers using a standardized approach. However, the literature suggests that implementing vocational training schools or mobile training schools would be more beneficial for low performers than on-site training (De Silva et al., 2023; Kataike et al., 2018). Formation of such schools facilitates networking that enables farmers to apply what they learn more naturally; part of this learning through networks could include benchmarking as associated processes stand analogous to the processes associated with benchmarking groups (Jack, 2012; Kahan, 2013; Saunders et al., 2007). Reverting to the Indian context, Kumar et al. (2023) present the implementation success of the 'Million Farmers School', opening up more training opportunities for BOP farmers with improved attendance/enthusiasm due to proximity at negligible cost. They further suggest that introducing an incentive scheme for farmers (e.g., providing tool kits, samples of high-quality inputs, etc.) and offering new knowledge and developments in the field will attract farmers to training centers. Improving a farmer's technical and business skills is extremely important for their profitability and livelihood (Khairallah et al., 2023; Mareth et al., 2019; Rosairo & Potts, 2016). Development initiatives for laggers may also focus on improving access to resources (e.g., access to financial institutions, and loan schemes) and enhancing infrastructure (e.g., proximity of milk collecting centers, and veterinary support) (Habib et al., 2024; Khairallah et al., 2023; Uddin et al., 2012).

As shown in Table 6.3, of the three types of farmer development support provided by the milk processor, all groups (but more the leaders) secured the highest mean score for evaluation and feedback on quality performance. This agrees with the literature as it is noted that milk processors give more focus on improving the quality and hygiene of the milk supply (Khairallah et al., 2023; Mulkerrins et al., 2023). It is suggested that the conceptual framework used in this paper could be used by the practitioners to better understand farmer development strategies.

Although L/cow/day is used as a metric in econometrics as a productivity measure (e.g., Bánkuti et al., 2020; Gáfaro & Pellegrina, 2022), this study showed that this metric is not a suitable metric to compare farmers (at least in contexts similar to Sri Lanka where there is wide variation in temperature, location, and cow breed within the country) because the metric assumes that all cattle are the same. It is recommended that the metric needs to be normalized (as done in this study) by taking the expected yield as the denominator.

Regarding environmental sustainability, the study found that leaders and accelerators perform better in this dimension compared to laggers (Table 6.2). This implies that the former two groups are more effective at implementing environmentally friendly farming practices, such as proper disposal of effluent, better utilization of agricultural waste, and reducing air pollution than the latter. According to the conceptual model, this discrepancy can be attributed to differences in farmer capability and the farmer-processor relationship. However, economic sustainability may also be indirectly influencing environmental sustainability. Korale-Gedara et al. (2023) pointed out that when dairy farmers are financially supported (e.g. financial support to improve the cattle shed) they can perform better in the environmental dimension.

Prior studies suggest that more experienced farmers are more successful in improving productivity and adopting advanced farming systems (Apparao et al., 2019; Maspaitella et al., 2018). However, the results of the present study (Table 6.3) indicate that experience is inversely proportional to performance in accordance with (Mareth et al., 2019) who found the same in Brazilian dairy context. Laggers had significantly more experience than accelerators, and accelerators had significantly more experience than leaders. This suggests that it is not merely the number of years in the trade that matters, but the quality of the experience farmers receive as explained by Mareth et al. (2019). Therefore, it is important to note that the findings of this study do not imply that experience is unimportant. The issue lies with laggers, most of whom are from Nuwara Eliya. Despite raising high milk-yielding exotic cows, these farmers face challenges not encountered by accelerators and leaders, most of whom are from Kurunegala. Exotic cows are expensive in the market and require commercially available, energy-dense animal feed, making them expensive and resource-intensive to maintain. In contrast, the cows raised by accelerators and leaders are cost-effective, easier to manage, and adaptable to semi-intensive or extensive farming approaches that suit their circumstances.

Another interesting finding that warrants discussion is that laggers received only two US cents less than accelerators (and leaders) from their milk processor for a Liter of milk supplied (Table 6.3). Although this two-cent difference was statistically significant based on one-way ANOVA ($F_{2,321}$= 4.57; $p$=0.011), it is not practically significant. The fieldwork revealed that most milk processing plants in Sri Lanka operate at about 70% capacity even during the peak period, and product quality thresholds are lowered to minimally acceptable levels. Thus, unlike in some developing countries, it appears that incentivization for supplying better-quality milk (Bánkuti et al., 2020) is not very apparent in Sri Lanka. It would be beneficial to benchmark Sri Lanka's context with those in India and Kenya (Ojha et al., 2017; Restrepo et al., 2020) to learn how the supply side and incentivization for quality are managed. It seems that inter-organizational collaboration and quality performance targets/benchmarks are effective in improving milk quality and motivating farmers to pursue quality (Defante et al., 2019).

### 6.5.3 Policy Implications

There is little doubt that private sector participation in milk processing improves efficiency due to increased competition. Processor-led farmer development is a positive outcome of significant private-sector involvement in milk processing. However, the study showed that in the Sri Lankan context, which may not be uncommon in some developing countries, allowing farmer development to be managed solely by the private sector may negatively impact low-performing farmers (laggers), whose low levels of economic sustainability are a case in point. The laggers were found to exhibit low levels of capability and relationships with the processor, suggesting that processor-led development has not been as effective for laggers as it has been for accelerators and leaders. As noted earlier, laggers exhibit a wide performance spectrum, and those in the bottom tier (e.g., within the lowest $25^{th}$ percentile) may be burdened with too many challenges to benefit from processor-led farmer development initiatives. A privately owned milk processor cannot be faulted for not focusing excessively on bottom-tier laggers. Therefore, policymakers must act to support bottom-tier laggers, who also happen to be smallholders in the main. One approach to developing smallholders could be to encourage them to view their farming operations as businesses (Rosairo & Potts, 2016; Sullivan, 2020; Vyas et al., 2020), focusing on maximizing resource use efficiency and effectiveness (Mareth et al., 2019). Activating farmer cooperatives could also be beneficial (Apparao et al., 2019). Government involvement could also tend to facilitate better financial assistance (e.g. via state-owned banks) and establishing government-owned extension service provisions (Taremwa et al., 2021; Uddin et al., 2012).

## 6.6 Conclusion

The present study, conducted in the context of a developing country, confirmed that dairy farmers vary widely in terms of sustainable performance, capability, and their relationship with the processor. The study brought novelty by being guided by introducing operations management concepts (SD and benchmarking) to a topic on agriculture. Consequently, the variables that formed three farmer groups (clusters) were guided by operations management theory, bringing a different angle to farmer development. Farmer and farm characteristics were used to better understand how they position within the clusters.

Regarding the identified clusters, farmers were labeled as laggers (low performance), accelerators (a significant improvement relative to laggers), and leaders (further improved performance but with diminishing returns relative to accelerators). The study identified weak areas needing improvement (e.g., low capability of laggers, who are mostly smallholders; low farmer economic performance) and provided suggestions for farmer performance improvement. Theoretical, practical, and policy implications of the findings were also highlighted.

The study is not without its limitations. It is important to reiterate that the study refers to a specific context (low participation in farmer development by all agents except the privately owned milk processor, exclusion of BOP farmers). In addition, Sri Lanka’s unique geography, characterized by two contrasting climates and land-use patterns, created a unique typology of dairy farming. The district with the hot climate had natural forage to support low milk-yielding cows of local and Indian crossbred origin, while the district with a favorable climate for raising high milk-yielding cows faced limited land availability, leading to intensive farming practices. This typology accounted for 95.6% of the laggers being found in one district adopting intensive farming, which has implications for generalizability. Therefore, any generalization of the findings to other contexts should be done with caution. However, the study's methodology can be analytically generalized to other developing country contexts. This is because whoever provides farmer development needs to provide training, financial support to improve a farming business, and feedback on how farmers are meeting the quality and other expectations of their customers, typically milk processors. The use of heard size and the sampling criteria has some limitations, such as potentially overlooking other contextual factors influencing performance (e.g., land size or access to resources). These limitations are acknowledged. It is suggested that further studies could be conducted in other developing countries using the same conceptual framework employed in this study, or a modified version if necessary to better represent the specific context of the country.

## Chapter 6, Appendix 1: The constructs, their measurement items, and their weights

| Construct | Indicator variable label: Short name | Weight |
|---|---|---|
| Farmer training | **FT1:** Training on milk production | 0.223 |
| | **FT2:** Training on animal health and care | 0.187 |
| | **FT3:** Training on improving milk quality | 0.203 |
| | **ET4:** Training on farm management | 0.195 |
| | **FT5:** Training on sustainable farming practices | 0.192 |
| Financial support (to improve the business) | **FS1:** Loans for dairy business | 0.107 |
| | **FS2:** Support for dairy equipment | 0.108 |
| | **FS3:** Support during hardships | 0.056 |
| | **FS4:** Animal feed at a reduced price | 0.124 |
| | **FS5:** Animal feed on credit | 0.183 |
| | **FS6:** Arrange third-party animal health services | 0.152 |
| | **FS7:** Better price for high-quality milk | 0.100 |
| | **FS8:** Timely payments | 0.169 |
| Evaluation and feedback on quality performance | **EF1:** Sharing milk quality improvement methods | 0.350 |
| | **EF2:** Efficient info-sharing platform | 0.315 |
| | **EF3:** Timely feedback on milk quality issues | 0.335 |
| Farmer capability VIF = 2.27 | **FC1:** Practicing learned knowledge via training | 0.201 |
| | **FC2:** Maintaining service relationships | 0.249 |
| | **FC3:** Year-round milk supply | 0.285 |
| | **FC4:** Conformance to quality specs | 0.265 |
| Processor-farmer relationship VIF = 2.19 | **Sat1:** Satisfaction with milk price | 0.102 |
| | **Sat2:** Satisfaction with net returns | 0.102 |
| | **Sat3:** Satisfaction with two-way communication | 0.102 |
| | **Tst1:** Trust in the processor's honesty | 0.100 |
| | **Tst2:** Trusting processor for assistance | 0.100 |
| | **Tst3:** Appreciate the processor's values | 0.100 |
| | **Tst4:** Appreciate the processor's proficiency | 0.100 |
| | **Com1:** Commitment to supply milk to the processor | 0.099 |
| | **Com2:** Willing to meet processor’s requirements | 0.099 |
| | **Com3:** Proud to be a supplier to the processor | 0.099 |
| Economic sustainability VIF = 1.95 | **EcnS1:** Satisfied with the gross income | 0.650 |
| | **EcnS2:** Income meeting household needs | 0.350 |
| | **EcnS3:** Satisfied with the overall profitability | -- |
| Social sustainability VIF = 1.73 | **SocS1:** Satisfied with resulting quality of life | 0.420 |
| | **SocS2:** Satisfied with children's education | 0.297 |
| | **SocS3:** Community recognition for mutual help | 0.283 |
| Environmental sustainability VIF = 1.78 | **EnvS1:** Proper effluent disposal (R) | 0.181 |
| | **EnvS2:** Solid waste usage for agriculture | 0.350 |
| | **EnvS3:** Reducing air pollution (R) | 0.469 |

**Notes:**

(1) The unit of analysis is an individual farmer.

(2) The description of the items in the questionnaire is limited to a few words only in this appendix. The full questionnaire can be obtained from the corresponding author.

(3) (R) represents the reverse coded statements

(4) The indicator weights were generated by PLS-SEM software in generating the scores of the constructs during the model validation stage (not part of this paper) for several purposes including testing the strength of the relationships (e.g., the $R^2$) between the independent variables and dependent variables.

(5) Indicator EcnS3 was not supported by the data during the model validation stage.

(6) The VIF values of the five cluster variables were obtained by regressing these five variables against an arbitrary variable in the questionnaire (milk supply), in multiple regression mode.

**Chapter 6, Appendix 2: One-Way ANOVA test results pertaining to Table 6.2 and Table 6.3**

| Variable | | The *p* value of the *F* statistic | Cluster Mean Values | | | The Difference Between Two Pairs of Custer Means (95% Confidence interval (CI)) based on Tukey's Post hoc Test | | |
|---|---|---|---|---|---|---|---|---|
| | | | Laggers | Accelerators | Leaders | 95% CI of Accelerators minus Laggers | 95% CI of Leaders minus Accelerators | 95% CI of Leaders minus Laggers |
| Cluster Variables | Farmer capability | <0.001 | 2.19 | 3.91 | 4.54 | 1.59 to 1.89 | 0.41 to 0.86 | 2.13 to 2.58 |
| | Processor-farmer relationship | <0.001 | 2.89 | 3.75 | 4.43 | 0.72 to 0.99 | 0.51 to 0.87 | 1.37 to 1.73 |
| | Economic sustainability | <0.001 | 2.07 | 3.36 | 4.34 | 1.06 to 1.53 | 0.66 to 1.30 | 1.96 to 2.60 |
| | Social sustainability | <0.001 | 3.36 | 3.94 | 4.72 | 0.43 to 0.75 | 0.56 to 0.99 | 1.15 to 1.58 |
| | Environmental sustainability | <0.001 | 3.19 | 4.22 | 4.80 | 3.09 to 3.29 | 4.63 to 4.96 | 4.12 to 4.33 |
| Additional Evaluation Variables | Farmer training | <0.001 | 2.50 | 3.56 | 3.72 | 0.68 to 1.46 | -0.37 to 0.68 | 0.68 to 1.74 |
| | Financial support | <0.001 | 2.03 | 3.10 | 3.57 | 0.89 to 1.23 | 0.24 to 0.70 | 1.31 to 1.76 |
| | Evaluation and feedback | <0.001 | 2.07 | 3.59 | 4.02 | 1.22 to 1.83 | 0.01 to 0.84 | 1.54 to 2.37 |
| | Schooling (Years) | <0.001 | 7.86 | 10.29 | 10.92 | 1.67 to 3.19 | -0.39 to 1.66 | 2.04 to 4.09 |
| | Experience (Years) | <0.001 | 24.20 | 15.67 | 14.35 | -11.65 to -5.40 | -11.65 to -5.40 | -14.04 to -5.66 |
| | Heard size (cows) | <0.001 | 6 | 11 | 11 | 3.69 to 6.85 | -2.34 to 1.90 | 2.93 to 7.17 |
| | Quantity supplied (L/day) | 0.005 | 38.05 | 29.17 | 31.98 | -15.26 to -2.51 | -5.71 to 11.33 | -14.61 to 2.47 |
| | Production (L/day) | 0.004 | 42.43 | 32.68 | 34.38 | -16.84 to -2.66 | -7.83 to 11.24 | -17.58 to 1.49 |
| | Cost of production (Eq. US$/L) | <0.001 | 0.32 | 0.18 | 0.08 | -0.17 to -0.09 | -0.15 to -0.05 | -0.28 to -0.18 |
| | Payment received (Eq. US$/L) | 0.011 | 0.38 | 0.40 | 0.40 | 0.00 to 0.03 | -0.02 to 0.03 | 0.00 to 0.04 |
| | Production (L/cow/day) | <0.001 | 8.89 | 3.51 | 3.72 | -6.39 to -4.36 | -1.15 to 1.58 | -6.53 to -3.79 |

**Note:** The exception is that the mean score (Accelerators – Laggers) >0; the mean score (Leaders – Accelerators) >0—hence by induction, the mean score (Leaders – Laggers) >0—for all the cluster variables and for some additional evaluation variables (for cost of production, the direction should be reversed). If the 95% CI of the mean difference (the last three columns) includes 0, the expected difference does not exist.

# CHAPTER 7:
# AN INDEX TO MEASURE THE OVERALL SUSTAINABLE PERFORMANCE OF DAIRY FARMERS UNDER BUYER INITIATED FARMER DEVELOPMENT PROGRAMS: A SRI LANKAN STUDY

This chapter has been submitted as a manuscript to the journal: Contemporary South Asia Journal and the manuscript is under peer review. Contemporary South Asia Journal (Publisher: Tailor and Francis, UK) seeks to address social science issues related to the South-Asian region by facilitating "cross-regional, and multidisciplinary research on South Asia".[21] This is one reason for selecting this journal, although the paper maintains an operational performance focus, and therefore does not cover social, cultural, and other region-specific issues in any detail. Contemporary South Asia Journal is classified as a Q2 journal with an impact factor of 0.5 in 2023 and cite score of 2.1. Some parts of this chapter were presented as an extended abstract titled "Developing an index to capture triple bottom line outcomes achieved by farmers in a developing country: an empirical study involving Sri Lankan dairy farmers" at the New Zealand Agricultural Resource Economies Society (NZARES) conference held in Wellington, New Zealand from 29th – 30th August 2024.

Specifically, this chapter demonstrates how a theory mindset (e.g., the cause-and-effect notion) and an empirical mindset[22] can be combined to generate an index to capture overall farmer performance. In this regard, this chapter is a natural extension of the previous chapter, which did not attempt to generate a composite score on the overall farmer performance. As with the previous chapter, the same five constructs—FC, PFR, Es, SS, and EnvS—have been treated as five different dimensions of farmer performance in creating an overall farmer performance. Regarding the findings, the chapter discusses how the empirically generated index can be used by milk-processes (or large-scale buyers in general) to efficiently monitor farmer performance and take necessary action to address performance gaps (examples are provided). The theoretical, practical, and policy implications are also discussed.

[21] Contemporary South Asia. (n.d.). Retrieved 02 January 2025 from https://www.tandfonline.com/journals/ccsa20

[22] The researcher users the term empirical to mean observed reality. For example, guessing a reasonably parameterized regression model based on one's understanding of what predictor variables might predict a certain response variable, and then fitting the regression model to the data collected.

**Abstract**

Dairy farmers in developing countries, including those in South Asia, can be supported by various buying companies such as farmer cooperatives, private milk processing companies, and multinational dairy corporations. When buyers engage in farmer development initiatives (e.g., training programs, financing) under a business model aimed at sustainable development, they need to monitor farmers' progress not only on operational parameters (e.g., milk volume, quality, delivery performance) but also on their triple-bottom-line (TBL) sustainability. Current performance measurement tools are inadequate for this purpose. The proposed overall farmer performance index and its accompanying scoring system—aligned with the United Nations' Sustainable Development Goals (SDGs) and the TBL sustainability framework—offers a tool for buying companies to monitor and guide Sri Lankan dairy farmers toward improved sustainable performance. An index-creation model for overall sustainable performance was developed from the literature and applied to data collected from 324 dairy farmers in the Kurunegala and Nuwara Eliya districts of Sri Lanka, which are the country's highest milk-producing regions. These farmers supply milk to a privately owned milk processing company actively involved in farmer development. The index-creation model was fitted to the data using the partial least squares structural equation modeling (PLS-SEM) and captures five performance dimensions: Farmer Capability, Processor-Farmer Relationship, Economic Sustainability, Social Sustainability, and Environmental Sustainability. The application of the index is demonstrated, and implications of the findings are discussed. To the best of the authors' knowledge, the proposed index is the first of its kind for this specific purpose.

**Keywords:** Farmer development, sustainable supplier development, sustainable development goals

**Paper type** Research paper

## 7.1 Introduction

Agriculture serves as the backbone of the livelihood of rural South Asia. The majority of the farmers in the rural communities of South Asia are smallholder farmers, and hence less agriculturally productive, and relatively poor (Sachitra & Chong, 2018; Siddiky, 2017; Vidanarachchi et al., 2019). These farmers tend to focus mostly on the income (economic) aspect of farming, overlooking the broader impact of sustainability (Aryal et al., 2020; Naveen et al., 2024). With the United Nations's (UN's) proclamation of sustainable development goals (SDGs) in 2015 for member counties and stakeholders (United Nations, 2015), "sustainability" has received a more balanced definition, which not only addresses the economic aspect of conducting a business but also the ecological and social aspects (Chand et al., 2015; Syahruddin & Kalchschmidt, 2011; Zanin et al., 2020). In line with the modern view of sustainability, many buying companies in value chains—agri-food or otherwise—have adopted the concept of sustainable supplier deployment (SSD). SSD focuses not only on enhancing the buying company's competitive performance but also on improving the economic, social, and environmental outcomes of their suppliers (farmers, in the case of agri-food value chains) through closer buyer-supplier relationships (Bai & Satir, 2022; Boscari et al., 2024).

Large-scale buyers of dairy farmers' produce—notably milk processing companies—often demand a consistent supply of high-quality fresh milk being supplied smoothly to enable their production systems to run efficiently (Food and Agriculture Organization of the United Nations, 2002; Kanire et al., 2024). To achieve these requirements, milk processing companies in developing countries that have an SSD focus can collaborate closely with farmers by providing training on sustainable farming practices and other development assistance farmers need, such as financing (Brix-Asala et al., 2021; Mukucha & Chari, 2021; Yawar & Kauppi, 2018). These efforts not only help farmers to improve per-unit output (e.g., yield per cow), product quality, and delivery performance but also their social and environmental performance (Hidayati et al., 2023; Yawar & Kauppi, 2018; Yawar & Seuring, 2018).

In the case of Sri Lanka, the urgency to improve the dairy sector performance, both on milk productivity terms and social terms, is important due to at least three reasons: high dependency on imports due to low growth of the local dairy industry, moderate per cow milk productivity, and region/district specific issues (Jayawardena & Samarasinghe, 2024; Neubert, 2016; Siddiky, 2017; Vidanarachchi et al., 2019; Weerarathna et al., 2024). The three problems are explained in turn. Only about 40% of Sri Lanka's demand for fresh milk is met through local production, with the balance having to be met through imports (Vidanarachchi et al., 2019). Due to the recent economic crisis faced by the country (Saliya, 2023) resulting in minimal foreign reserves, over-reliance on milk imports has become an even more serious problem. Regarding per-cow milk productivity, Sri Lanka is a distant third in the South Asian region (683.26 kg/cow/year), way behind Pakistan (1229.96 kg/cow/year) and India (1191.54 kg/cow/year), showing the performance gap that needs to be bridged by Sri Lanka through productivity improvement (Siddiky, 2017). Regarding a region-specific example, although the Nuwara Eliya district of Sri Lanka (upcountry plantation sector in general) has a favorable climate to raise high milk-yielding exotic cows, farmers in this district have been performing poorly in productivity terms as well as social and economic terms, due to district-specific issues such as an aging farming population, generally overlooked well-being of the people living in the upcountry plantation sector, high input prices making intensive farming uneconomic, and lack of veterinary services (Neubert, 2016; Vyas et al., 2020; Weerarathna et al., 2024).

To improve the performance of any business, small or large, its overall performance needs to be measured along with the performance in the individual dimensions that constitute the overall performance, to take corrective action to make the business sustainable (Buonasera et al., 2025; Kaplan, 2009; Saunila et al., 2024). In an agri-food VC involving smallholder farmers, the farmers often lack the skills to measure the performance of their farm businesses. However, the focal company driving the VC, such as a food processing company, can establish a farmer performance measurement and management system to improve farmer performance, which, in turn, improves the performance of the focal company and the VC as a whole (Hidayati et al., 2021; Morales et al., 2022; Saunila et al., 2024).

Although farmer performance monitoring systems are available, it is argued that these frameworks are not well-suited to the unique challenges faced by farming in developing countries including that of Sri Lanka (Chand et al., 2015). This study aims to address this gap by developing an easy-to-use performance measurement (PM) index—aligned with the UN's SDG goals—using an empirical approach: constructing a model and estimating its parameters by fitting the model to data. Sri Lanka was selected as the context for developing the PM index to leverage an ongoing farmer development project in the country, and also for the abovementioned performance improvement need of Sri Lanka's dairy VC.

The importance of this study is fivefold. First, there is a need to improve the performance of dairy farmers in Sri Lanka; measuring farmer performance is a starting point for performance improvement interventions, and this study addresses that need. Second, for a farmer performance measurement index to become more accurate in a particular context, it must be optimized for that context. This study addresses this need by developing an overall farmer performance index and its accompanying scoring system, both of which have been tailored to fit the Sri Lankan context. Third, the study demonstrates how the scoring system can be used by milk processing companies engaged in SSD to enhance the efficiency of farmer performance improvement. Fourth, the scoring system enables milk processing companies to facilitate sustainability reporting by systematically measuring and reporting their contributions. This demonstrates transparency in improving the economic, social, and environmental outcomes of their farmers. Finally, the method used to develop the index is novel, and the methodology is analytically generalizable to other AVC within and beyond Sri Lanka.

The paper is structured as follows: Section 7.2 reviews the theoretical background, highlighting the need for a performance index on overall sustainable farmer performance. Section 7.3 details the methodology, including the empirical approach to developing the index, specifying it as a statistical model with weighted parameters, and data collection. Section 7.4 presents the results and discussion, demonstrating how the model informs a scoring system to evaluate farmer sustainability and its practical application by milk processors to streamline training. Section 7.5 concludes with theoretical, practical, and policy implications and suggests directions for future research.

## 7.2 Literature review

### 7.2.1 Adaptation of the concept of 'supplier development' to agriculture

In the field of operations management, it has been argued that a manufacturer can gain a competitive advantage by developing the performance of its core suppliers—a concept known as supplier development. In the literature, product quality, delivery, and value/cost have been considered as supplier performance attributes frequently (the core supplier performance attributes), but flexibility, supplier practices, supplier's environmental performance, and other buyer-desired characteristics have also been used in some studies, both during the supplier selection stage and supplier performance monitoring stage, under supply contracts (Benton et al., 2020; Dey et al., 2015; Wagner, 2009). The core attributes of supplier performance apply to AVCs, but due to their nature and other limitations—for example, perishability of the produce, variations in farm production due to uncontrollable factors, and limitations in the application of technology—have made supplier performance on traditional criteria of supplier performance being subjected to high vibration (de Lange et al., 2025; Pham et al., 2019).

The integration of sustainability into supplier development and its appearance in agri-food literature became more prominent in the early 2000s, spurred by the growing interest in sustainable supply chain management and the recognition of the importance of mutual support between buyers and suppliers (Khan et al., 2021; Mardani et al., 2020; Yawar & Seuring, 2018). This shift led to the emergence of the concept of sustainable supplier development (SSD), which refers to the initiatives by a buying firm to enhance its supplier's environmental, social, and economic performance for the long-term sustainability of the supply chain (Bai & Satir, 2022; Pedroso et al., 2021).

The instrumental stakeholder theory holds that stakeholder relationships characterized by ethical principles such as trust and cooperation lead to improved creation of stakeholder wealth (Bridoux & Stoelhorst, 2022; Jones et al., 2018). Using this theoretical lens to examine an AVC in a developing country, this paper argues that the SSD initiatives implemented by a milk processor can lead to mutually beneficial outcomes for both the processor and the farmer, such as increased profitability (through improvement of farm productivity, which covers per-cow output, milk quality), enhanced competitiveness, and long-term sustainability—at the same time, strengthening the Processor-Farmer Relationship (PFR) (Arshad et al., 2024; De Silva et al., 2023; Le, 2023). The implication is that for a milk processor, investing in improving the capacity of its farmers to be productive is a strategic decision that boosts the firm's financial performance. A strong PFR and improved farmer capability (FC), in turn, improve the farmers' livelihoods and promote the adoption of more sustainable farming practices (Valentinov & Hajdu, 2021). Note that FC in this study means farmer's performance on milk quality, delivery, applying knowledge received from training to improve farm productivity, and maintaining service relationships (De Silva et al., 2023; Nath et al., 2010; Sachitra & Chong, 2018).

Although the aim remains the same, SSD initiatives implemented by a buyer can vary significantly, depending on the context (Flores et al., 2023; Kataike et al., 2018; Kumar et al., 2023). Since this study focuses on agri-food in a developing country, three broad SSD initiatives have been identified based on the available literature (Brix-Asala et al., 2021; De Silva et al., 2023; Ladele & Kuponiyi, 2006; Pedroso et al., 2021; Syahruddin & Kalchschmidt, 2011; Yawar & Seuring, 2020; Zuza et al., 2024). Those are farmer training, financial support, and feedback on farmer's quality performance.

### 7.2.2 Measuring farmer performance – Existing approaches

There is a wide array of assessment tools that measure a dairy farmer's or a farm's sustainability performance. Each varies in its scope, target groups, indicators, methods, and/or execution time (De Olde et al., 2016; Janker & Mann, 2020). Cammarata et al. (2021) used the Sustainability Assessment of Food and Agriculture Systems (SAFA) tool for assessing organic dairy farms in Sicily, Italy. A comparative study by De Olde et al. (2016) found Response-Inducing Sustainability Evaluation (RISE) as the most relevant tool for Danish dairy farms, while Feil et al. (2023) found Global Reporting Initiative (GRI) guidelines as the most relevant for Brazilian dairy farmers. It is argued that tools developed for developed countries (e.g., RISE and SAFA) are not good fits for many developing countries due to small-scale farming, limited resource availability, low intensification, and low stakeholder involvement (Schindler et al., 2015; Zhen & Routray, 2003). It is also believed that complex tools (e.g., GRI, Life Cycle Assessment, and carbon footprint analysis) may also be difficult to use to examine smallholder farmer performance in developing countries due to resource constraints, exploitation within the VC, and immediate economic priorities. As the literature suggests (e.g., Chand et al., 2015; Munyaneza et al., 2019), it is argued that using an existing set of indicators, without prior customization to fit a developing country, could provide misleading information to the users including the processors.

### 7.2.3. The conceptual framework

A milk processor would want to track its farmers' capability improvements, as a weak link between farmer development initiatives (the cause) and FC (effect) means that the farmer will not improve the farmer performance attributes—as mentioned earlier, quality, delivery, application of knowledge received from training, and service relations—that are important to the processor for their completeness, questioning the returns for the processor on their investment (De Silva et al., 2023; Mukucha & Chari, 2021; Pedroso et al., 2021). If FC does not improve—through the processor's farmer development initiatives—these initiatives would not have an impact on farmer's TBL sustainability through the positive association between FC and farmer's TBL sustainability (De Silva et al., 2023; Yawar & Seuring, 2018; Zanin et al., 2020).

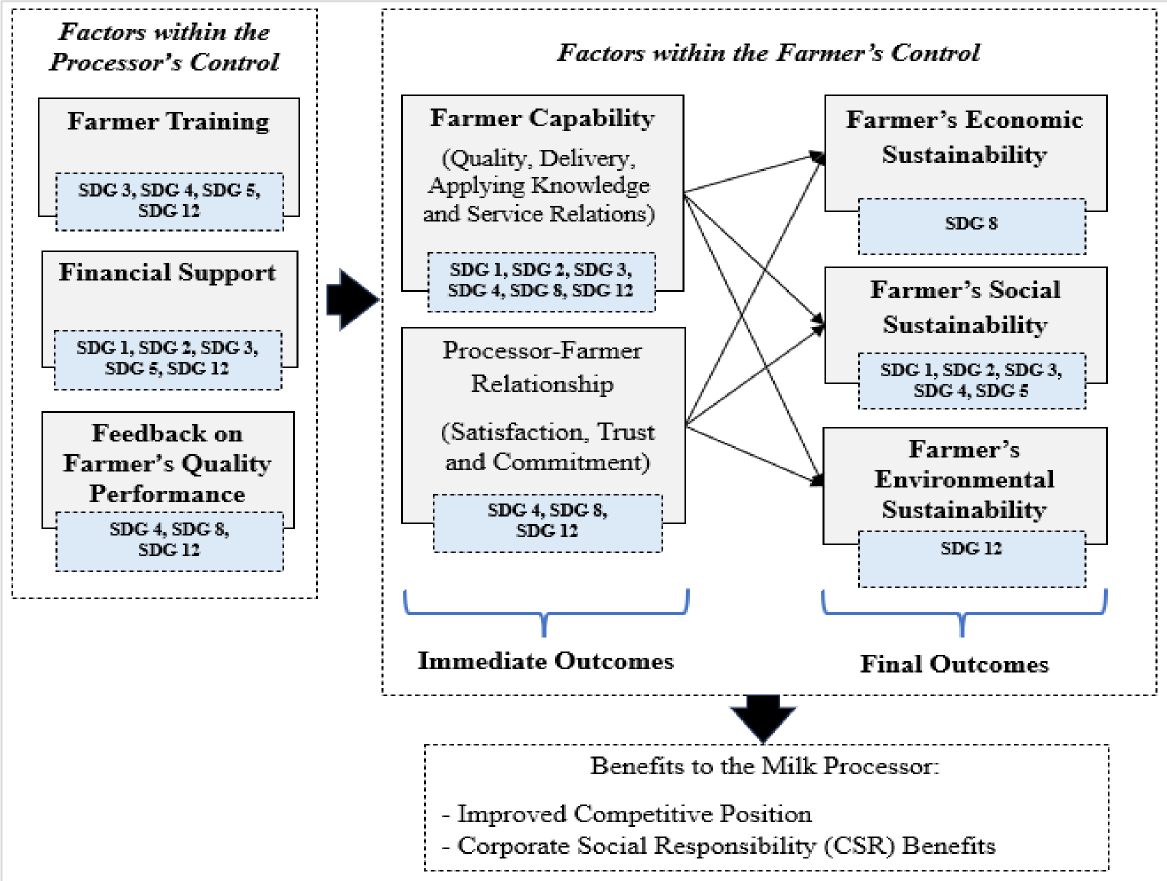



**Figure 7.1 The conceptual framework of the study**
*(Source: Own work)*

A milk processor would want to track the PFR, as a weak link between farmer development initiatives (the cause) and PFR means that farmer development initiatives would not result in increasing farmer satisfaction, trust, and commitment—the gains envisaged by the processor (De Silva et al., 2023; Owot et al., 2024). If the PFR does not improve—through the processor's farmer development initiatives—these initiatives would not have an impact on farmers' TBL sustainability through the positive association between the PFR and farmers' TBL sustainability (De Silva et al., 2023; Lees et al., 2020; Yawar & Seuring, 2018). Given the above, the conceptual framework that underpins the development of the PM system is shown in Figure 7.1.

### 7.2.4 Alignment of the conceptual model to UN's SDGs

The UN defines sustainable development as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987, p. p. 292). The UN's Agenda 2030 provides countries with a holistic multidimensional plan of action for their people, planet, and prosperity (Pradhan et al., 2017). Agenda 2030 outlines 17 SDGs with 169 targets that demonstrate the scale and ambition of this universal agenda. These goals are interconnected, offering potential synergies and trade-offs, to balance the three sustainability pillars: economic, social, and environmental. An organization (in the present study a milk processing company) can contribute to realizing SDGs in a concrete way with a conscious understanding, by incorporating sustainable development into organizational strategies and effective implementation (Hummel & Szekely, 2022; Le, 2023; Miola & Schiltz, 2019). As implied in the conceptual framework, a processor should monitor the immediate outcomes of their farmer development initiatives—FC and the PFR—as well as the final outcomes if they are to truly play their part in assessing their contribution towards achieving SDGs (Miola & Schiltz, 2019). SSD practices initiated by a milk processor in a developing country could focus on the following SDGs: SDG1-no poverty, SDG2-zero hunger, SDG3-good health and well-being, SDG4-quality education, SDG5- gender equality, SDG8-decent work, and economic growth, and SDG12-responsible consumption and production (Le, 2023; Zimon et al., 2020). The processor-initiated farmer development initiatives conceptualized in this study include farmer training, financial support to enhance farm businesses, and information sharing (in the form of evaluation and feedback) to improve farmers' performance. These initiatives can align with the SDGs as follows:

- Farmer training (including spouses) covers milk productivity, animal health and care, quality assurance (including food safety), entrepreneurship, and sustainable farming practices such as safe chemical use, cleaner production methods, and occupational health and safety. These efforts improve farmers' and spouses' human capital through lifelong learning (SDG 4), promote gender equity (SDG 5), encourage sustainable resource use (SDG 12), and support the health and well-being of farming households (SDG 3).
- Financial support including monetary assistance, materials, equipment on concessionary terms, and timely payments—helps smallholder farmers stay above the poverty line (SDG 1), ensures adequate family nutrition (SDG 2), and empowers women by entrusting them with financial management responsibilities (SDG 5) while also provides a decent work environment that contributes to economic growth (SDG 8)
- Information sharing in the form of evaluation and feedback on farmers’ quality performance improves their knowledge (SDG 4), facilitates economic growth through a decent work environment (SDG 8), and reduces waste while promoting sustainable resource use (SDG 12).

The remaining constructs of the conceptual framework have been aligned with the relevant SDGs using similar reasoning.

## 7.3 Methodology

### 7.3.1 Development of the empirical model and parameter estimation

Farmer performance constructs (referred to as factors in Figure 7.1) FC, PFR, Farmer Economic Sustainability, Farmer Social Sustainability, and Farmer Environmental Sustainability were treated as the components of the index representing a farmer's sustainable performance. As mentioned earlier, FC is a fundamental farmer performance construct that is of great importance to the milk processor, and also FC enables a farmer's TBL sustainability; a similar argument was presented for conceptualizing the PFR as an enabler of a farmer's TBL sustainability. The combined contribution of FC and PFR towards sustainable farmer performance is referred to as 'The Contribution of the Sustainability Enablers' in this study. The farmer is the unit of analysis.

The partial least squares structural equation modeling (PLS-SEM) technique (Hair Jr et al., 2022) was used to fit the index-creating model to indicator data collected via a survey questionnaire (details in section 7.3.2). PLS-SEM was used as the suitable technique because all the constructs specified in the theoretical model (Figure.7.2) are modeled as formative constructs; formative constructs are constructs whose meaning is formed by its indicators, which means that without its indicators, a formative construct has no meaning (for details see Diamantopoulos et al., 2008; Hair Jr et al., 2022). SmartPLS 4 (Ringle et al., 2024) statistical software package was used to execute the PLS-SEM algorithm.

As shown in Figure 7.2, the empirical model developed for the computation of the overall sustainability index of a farmer consists of 32 unknown weights (34 were considered initially, but $w_{ns1}$ and $w_{ns1}$ in Eq1 and Eq3 respectively were nonsignificant, and hence 32 remained in the final reckoning); the figure also depicts the estimated values of these weights, once the model has been fitted to the data. The higher-order PLS-SEM model used in the study consists of three sub-models: Model 1, Model 2, and Model 3. Each model is optimized separately: Model 1 optimizes its parameters as a second-order formative-formative construct (Crocetta et al., 2021) representing 'The Contribution of the Sustainability Enablers'. Model 2 optimizes its parameters as a second-order formative-formative construct representing farmer's TBL sustainability. Finally, Model 3 combines the contributions of two second-order constructs to determine the contribution (weight) that should be assigned to each second-order construct in formatting the performance index 'Overall Sustainability of the Farmer'. Each construct in each model is represented as a weighted linear combination of its indicators. As an example, the equations (Eq1, Eq2 and Eq3) pertaining to Model 1are as follows:

FC = *w1*CAP1 + w2*CAP2 + w3*CAP3 + w4*CAP4* **Eq1**

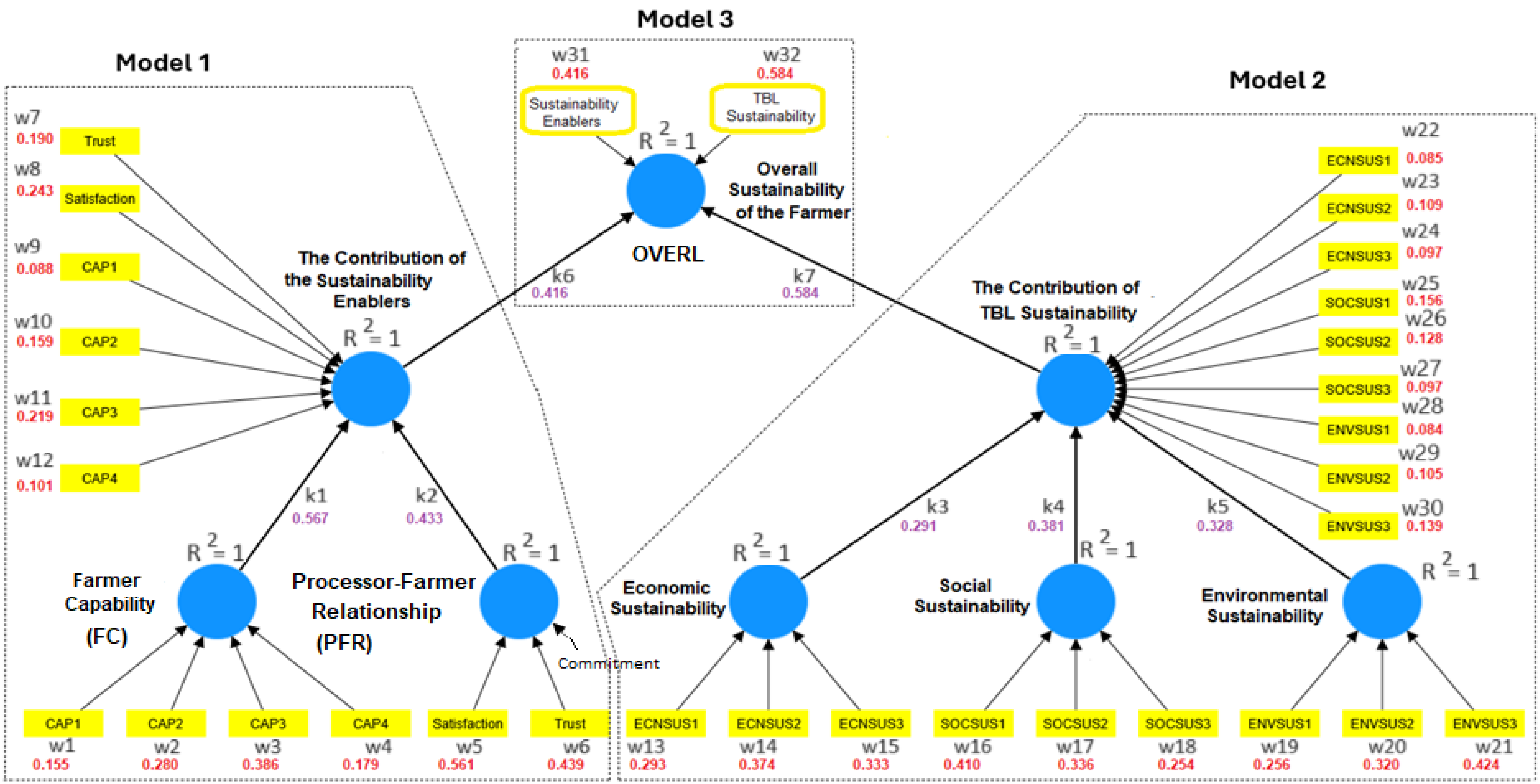
PFR = *w5*Satisfaction + w6*Trust +* $w_{ns1}$**Commitment* ` **Eq2**

Note that Commitment was not accepted as a predictor of PFR—the weight $w_{ns}$ was statistically nonsignificant—and hence Commitment does not feature in the results section (a possible reason for nonsignificant weight has been given).

The Contribution of the Sustainability Enablers = *w7*Trust + w8*Satisfaction +* $w_{ns2}$**Commitment + w9*CAP1 + w10*CAP2 + w11*CAP3 + w12*CAP4* **Eq3**

The way the equations have been specified ensures that when the indicator data is fitted to the SEM, the response (e.g., in Model 1, 'The Contribution of the Sustainability Enablers') would be predicted by its predictors (in Model 1, FC and PFR) perfectly (i.e. $R^2$=1). This is because all the indicators of the predictors become the indicators of the response, as required in the second-order model specification in PLS-SEM (Hair Jr et al., 2022).

The equations pertaining to Model 2 are similar to those of Model 1. In estimating the weights k6 and k7 (=w31 and w32, respectively) of Model 3, 'The Contribution of the Sustainability Enablers' and 'The Contribution of TBL Sustainability' were used as both predictors and indicators of the 'Overall Sustainability of the Farmer' to meet the $R^2$=1 requirement used in a formative-formative conceptualization (see Hair Jr et al., 2022 for details). Before taking in the parameters estimated by SmartPLS 4 software, their statistical significance was examined. However, the reader should note that since PLS-SEM does not rely on parametric assumptions (e.g., normal distribution), it is reliant on the bootstrapping technique to report the critical ratios (the T values) and the *P* values of the parameters (Hair Jr et al., 2022).




**Notes:** (1) w1 to w32 are indicator weights, while k1 to k7 are regression weights; (2) Commitment as a predictor of PFR was rejected by the data. Hence no weight was assigned to Commitment

**Figure 7.2 The farmer's overall sustainability index creation model with estimated parameters**

*(Source: Own work)*

### 7.3.2 Designing the data collection instrument and data collection

A survey questionnaire was developed by the authors based on the literature. Farmer capability has been operationalized using 4 indicators (De Silva et al., 2023; Nath et al., 2010; Sachitra & Chong, 2018). The processor-farmer relationship has been operationalized using 10 indicators (4 indicators for trust, 3 indicators for satisfaction, and 3 indicators for commitment) (De Silva et al., 2023; Lees et al., 2020; Owot et al., 2024). The three constructs–economic, social, and environmental sustainability have been operationalized using 3 indicators for each (De Silva et al., 2023; Lebacq et al., 2013; Zanin et al., 2020). Each statement in the questionnaire represented an indicator (a measurement item) of a construct in the model (Figure 7.2) and the respondents (farmers) were asked to agree to the statements on a 1-5 scale. What the questionnaire items contain can be understood by the headings given to the items in Chapter 7, Appendix 1. Readers can obtain the questionnaire from the corresponding author.

The survey targeted farmers supplying milk to a large privately-owned Sri Lankan milk-processing company that provides in-house training. The company trains farmers who either consistently supply $\geq$20L of milk per day or own $\geq$5 milk-bearing cows, utilizing its extensive network of extension officers. The sampling frame for the survey comprised farmers from the two largest milk-producing districts in Sri Lanka: Nuwara Eliya and Kurunegala. Farmer contact details in these districts were sourced from the company's training register.

A total of 400 farmers—200 from each district, randomly selected from the sampling frame—were contacted by phone to explain the study and invite their participation. Of those contacted, 324 (115 from Nuwara Eliya and 169 from Kurunegala) agreed to participate, and data was collected from these respondents. Research assistants (RAs) trained by the first author visited each farmer at their farm. This approach was employed to ensure a high response rate and minimize missing data.

## 7.4 Results and discussion

### 7.4.1 Results on the newly developed farmer sustainable performance scoring system

PLS-SEM bootstrapping results showed that the two parameters related to the indicator 'Commitment' were statistically nonsignificant but the remaining 32 parameters were statistically significant ($p$<0.05), as mentioned earlier. A reason for Commitment to become a nonsignificant predictor of PFR is believed to be attributable to the fact that PFR is a behavioral construct (i.e., a construct that possesses psychometric properties including intercorrelated indicators) that should best be represented as a scale rather than an index. The fact that all the other constituents of the index on the Overall Sustainable Performance of the Farmer (OVERL) were significant (i.e., the 32 parameters) and no significant predictor collinearity issues were identified, it is concluded that the specified model is statistically valid, based on the validation guidelines used in PLS-SEM involving formative constructs (Hair Jr et al., 2022).

To align the estimated weights with a scoring system developed in this paper—1000 points have been allocated as the maximum possible overall sustainable performance of a farmer—re-scaling was done to convert the 1-5 scoring system (Likert scale) to match the 0-1000 scoring system. For example, since 1000 points are allocated for OVERL, 'The Contribution of the Sustainability Enablers' should secure 416 points while 'The Contribution of TBL Sustainability' should secure 584 points, because the weights k6 and k7 (= w31 and w32 respectively) were estimated to be 0.416 and 0.584 respectively (more details in Chapter 7, Appendix 1).

It is important to note that the weighted estimates shown in Figure 7.2 are valid only for the 1-5 Likert scale used to collect data. Chapter 7, Appendix 1 outlines the contributions of each element of the PM system when a maximum possible 1000 points are allocated to OVERL. The points were calculated by transforming the index OVERL (valid for a 1-5 scale) into a 0-1000 scale using the equation 'new weight = 250*old weight – 250'. Back translating this scoring system used to create the index OVERL in a 0-1 scale (i.e., each construct measured in a 0-1 scale) as a linear combination of its five constructs leads to the following relationship:

$$OVERL = 0.236*FC + 0.180*PFR + 0.170*ECONS + 0.223*SOCLS + 0.190*ENVTS \quad \text{Eq4}$$

Where:.

*ECONS* - Farmer Economic Sustainability.

*SOCLS* - Farmer Social Sustainability.

*ENVTS* -Farmer Environmental Sustainability.

As shown in Chapter 7, Appendix 1, the five components of Eq4 can be resolved into its items to express OVERL as a linear combination of 15 items (CAP1 through ENVSUS3). It is argued that a farmer PM system that contains 15 measurement items to monitor—if only one key performance indicator (KPI) can be used to represent each item—monitoring 15 KPIs of farmers is a doable task, through an efficient reporting system (Kaplan, 2009; Lai et al., 2022). Besides, to improve OVERL, FC, and PFR need to be improved first based on the conceptualization used in the paper (Figure 7.1). Hence a milk processing company could focus their attention on improving the KPIs of FC and PFR of their farmers—hence fewer KPIs to monitor—initially (this is discussed in section 7.4.3).

Of the 324 farmers who responded to the questionnaire, 227 (70%) were found to be smallholder farmers (less than 10 milk-yielding cows) and 97 (30%) were found to be medium-scale farmers (10-40 milk-yielding cows). Sufficient variability between farmers, in terms the herd size, farming method, cow breeds, and a wide range of farmer productivity characteristics implied sufficient farmer heterogeneity for the findings to be useful.

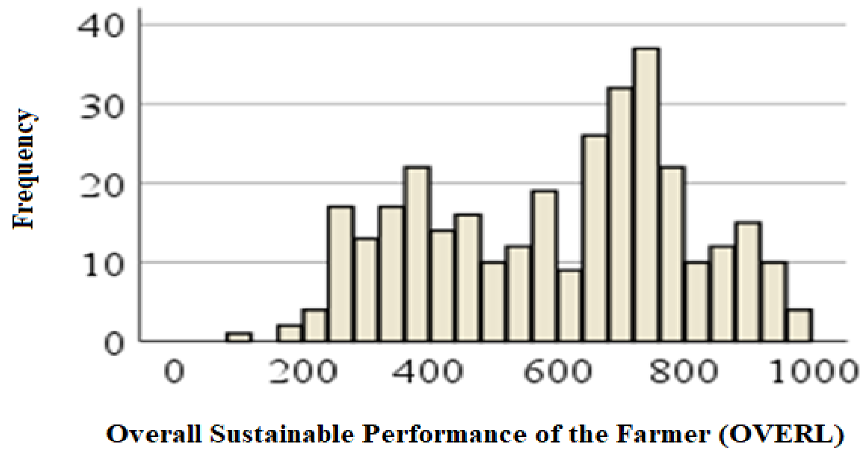
### 7.4.2 Discussing the results obtained by applying the measurement system

The measurement system designed by the authors can be utilized by a milk processor in at least two ways to monitor farmers' sustainability and provide group-based training: (i) grouping farmers based on their OVERL scores across the entire spectrum; and (ii) grouping them according to farmer typologies that are thought to be showing—for example, based on the milk processor's experience—performance gaps.

#### *7.4.2.1 Training by grouping farmers based on their OVERL scores across the entire spectrum*

Based on the OVERL score of every farmer in the training program, the farmers could be grouped based on the distribution of their OVERL scores. Figure 7.3 depicts the distribution of the OVERL scores of all 324 farmers in the sample. In this sample, the farmers in the interquartile range (i.e. between Q1 and Q3) could be considered as medium performers (the bulk of the farmers would be in this range), the farmers up to the first quartile (Q1) as poor performers, and farmers beyond the third quartile (Q3) as high performers. Generally, in improvement science, the training methods that should be used for low performers would be different from those used for medium performers and high performers; whereas poor-performing farmers could benefit from field schools, peer group engagement, and even simple demonstrations by extension staff, the better-performing farmers could benefit from more formal training programs  (Davis et al., 2012; Feder et al., 2004; Tricarico et al., 2020).

Based on the first quartile (Q1) value of 416 points in the frequency distribution (Figure 7.3), it can be said that farmers who secure an overall score of 416 points or less (25% of the farmers) are farmers who are at the early stages of their journey towards sustainable performance, these farmers need to learn the basics. On the same token, it can be said that farmers who return an overall score of 750 points (Q3) or more have reached a commendable level in their journey towards sustainable performance and could be motivated to perform better (e.g., incentivize them to increase their supply, encourage more automation and provide financing, recognize as leaders to foster more fruitful PFRs) (Bhatti et al., 2021).




**Note:** Mean=601; StDev=206; Min=99; Max=992; Q1=416; Q2 (Median)=649;

**Figure 7.3 The distribution of the OVERL scores of the sample**
*(Source: Own work)*

The reader will note from Figure 7.3, that the distribution of the overall farmer sustainability scores is seemingly bimodal (a low-performing group and a high-performing group, broadly speaking). A possible reason for this could be distinct types of farming methods being practiced by the farmers or other known reasons that could be attributed to farmer typologies, which are discussed next.

*7.4.2.2 Training by grouping farmers based on a known farmer typology*

A milk processor could analyze the OVERL score and its components, based on farmer typologies identified by them. The farming method being used by the farmers is used as an example as it is a relevant typology for farmer performance analysis in Sri Lanka. Intensive farming is a farming method/system that involves using a smaller land area to raise the cows resulting in a higher stocking rate (cows per hectare). Intensive farming relies heavily on capital-intensive practices, such as feeding cows with commercially available animal feed. In contrast, extensive farming is a farming method/system that requires a larger land area to raise the cows, resulting in a lower stocking rate and a lower capital intensity. This method typically depends on grazing cows on large pastures with minimal reliance on commercial animal feed. Semi-intensive farming falls between intensive and extensive farming, incorporating elements of both approaches (Novikova & Startiene, 2018; Nyokabi et al., 2021; Vidanarachchi et al., 2019).

One of the known barriers in Sri Lanka to achieving high sustainable dairy farmer performance (hence a high OVERL score), especially by those who are heavily reliant on commercially available animal feed—farmers who use intensive farming—is the scarcity of high-quality, energy-dense animal feed (Vidanarachchi et al., 2019; Vyas et al., 2020; Wijethilaka et al., 2018). It is known that farmers in the Nuwara Eliya district raise exotic cow breeds (Jersey, and Holstein-Friesian) which are by nature, high milk-yielding cows, but the limited supply of high-quality commercially available animal feed required for these cow breeds (large grasslands for grazing are not available in the Nuwara Eliya district which is better known for the famous 'Ceylon Tea') cause Nuwara Eliya farmers to underperform (Vyas et al., 2020; Weerarathna et al., 2024). The high price of animal feed (partly due to the limited supply) and high overheads mean farmers in the Nuwara Eliya district who nearly always use intensive farming may fail to meet the milk volume expectations and face economic loss, resulting in a lower score.

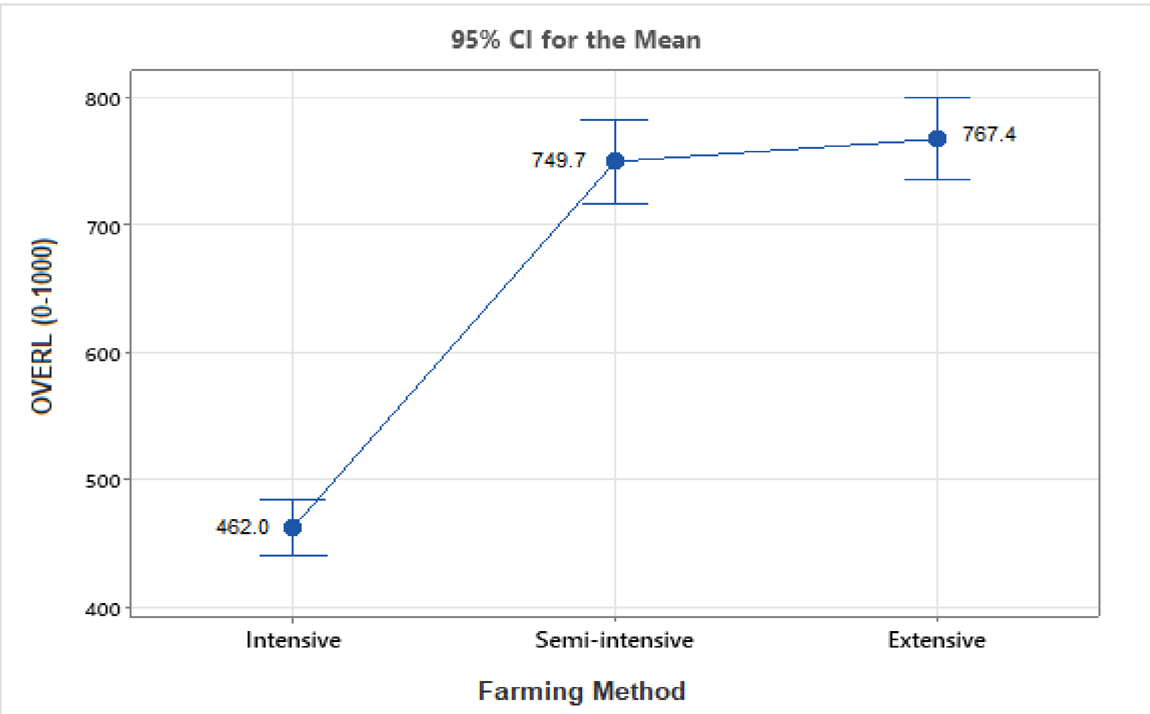



**Figure 7.4 The mean OVERL score of the farmers based on the farming method**
*(Source: Own work)*

Figure 7.4 illustrates the mean OVERL scores of farmers in the sample across the three farming practices, highlighting that the intensive farming cohort (*n*=172) consistently underperforms both absolutely and relative to the semi-intensive cohort (*n*=74) and the extensive cohort (*n*=77). However, Figure 7.5, showing the distribution of OVERL scores for farmers in the intensive farming group, indicates that some farmers in this cohort are performing exceptionally well, with six achieving scores >800. The milk processor could leverage these high performers to share their success stories with the low-performing peers, peer-educate the latter informally, and/or use the high performers in other ways for similar purposes (Bhatti et al., 2021; Zossou et al., 2012). Also, the milk processor could use their own skills and expertise to help low and middle-performers achieve their true potential. One possible way to start this would be by looking at the mean scores of the five categories of the OVERL score of the farmers who adopt intensive farming.

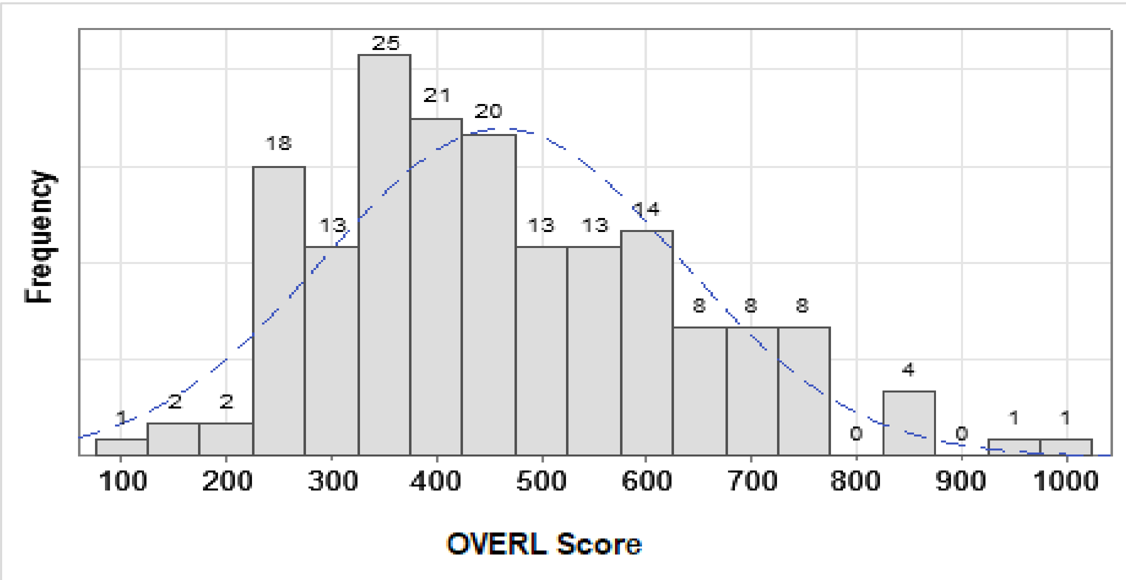



**Figure 7.5 The distribution of the OVERL score of the farmers adopting intensive farming**
*(Source: Own work)*

Figure 7.6 depicts the mean and best-performing scores for each sustainable performance category among farmers practicing intensive farming. On average, these farmers seem to perform particularly poorly in FC and PFR—two areas critical to the milk processor. If farmers fail to meet quality and delivery expectations, struggle to apply what they learn, maintain poor service relations (all linked to FC), feel dissatisfied with the processor relationship, or exhibit low trust in the processor (both related to PFR), this highlights the need to re-engineer training programs and other farmer development initiatives for those engaged in intensive farming.

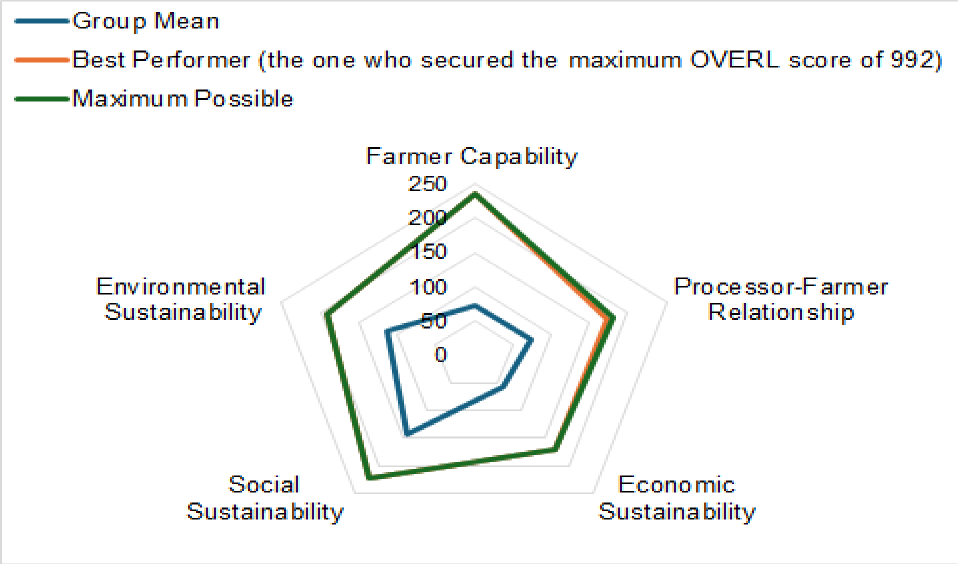



**Figure 7.6 Per-category performance of the farmers adopting intensive farming**
*(Source: Own work)*

### 7.4.3 Discussion of the results from a milk processor's sustainability standpoint and SDGs

Companies in developing countries—not just the ones in developed countries—should focus their attention on corporate social responsibility (CSR) and voluntary sustainability reporting, which is reporting the economic, social, and environmental impact a company has made over the reporting period, through its activities (Farisyi et al., 2022; Girón et al., 2021; Tauringana, 2021). One of the main aims of following an acceptable voluntary sustainability reporting standard is demonstrating transparency in the company's activities in engaging with the stakeholders (Farisyi et al., 2022; Girón et al., 2021).

Dairy farmers are key stakeholders of a milk processing company. Hence, reporting the gains to the farmers who supply milk to them—who are part of the community—through the company's interventions to improve dairy farmer sustainability is strategically important to the company. Using a context-specific validated PM system has at least three advantages. First, it gives the company the confidence that the PM system they use guides them by way of showing how different elements of the PM system (e.g., measurement categories, their items, the relative importance of every category and item, and the KPIs corresponding to each item) are theoretically and practically related to one another in improving dairy farmer sustainability (Bourne et al., 2003; Damtoft et al., 2025); in addition, as demonstrated in the scoring system (Appendix 1), a theoretically and practically valid measurement system informs the company what measurement categories and items are more important to them than the others in causing dairy farmer sustainability. Stemming from the first advantage, incorporating KPIs into the PM system becomes more straightforward as the 15 theoretically and practically valid measurement items are known to the company. Finally, using a validated PM system enhances the transparency of CSR and sustainability reporting (Asiaei et al., 2021; Damtoft et al., 2025). A discussion around the previously mentioned points based on the study findings follows.

FC commanded the highest points (=236) in the scoring system, which is intuitively interpretable because FC is the construct/category that drives the productivity of both the farmer and the milk processor (e.g., through delivery and quality compliance and service relations), as mentioned earlier. Improving FC by diverting more resources to improve FC is also beneficial to the milk processor as FC is aligned with as many as six SDGs (SDG1-4, SDG8, and SDG 12), as shown in Figure 7.1.

Among the three TBL performance categories in the scoring system, the social sustainability category secured the highest points (=223), highlighting its significance to the farmers (Orou Sannou et al., 2023; Yawar & Seuring, 2018; Zhen & Routray, 2003). Improving the social sustainability of the farmers is also important to the milk processor's sustainability reporting because the social sustainability of the farmers is aligned with five SDGs (SDG1-5), as shown in Figure 7.1. The social sustainability score underscores the importance of community engagement and capacity-building in achieving production goals (Feder et al., 2004). By empowering farmers and addressing social inequalities through SSD initiatives, milk processors can create more resilient suppliers who are better equipped to implement sustainable practices. The environmental sustainability category, which secured the second highest points (=190), measures the extent to which farmers adopt environment-friendly production practices. This includes proper effluent disposal, using solid waste for agricultural use, and mitigating air pollution, all of which can be enhanced by farmer training (De Silva et al., 2023; Korale-Gedara et al., 2023). For instance, when a farmer receives training on environment-friendly practices such as sustainable solid waste management (e.g., the use of a natural filtration system that prevents water contamination and minimizes overall environmental impact) will be able to improve their milk quality and milk hygiene, which could command higher payments (Korale-Gedara et al., 2023). Thus, farmer training and the resulting immediate outcome of enhancing FC extends the processor's environmental impact beyond its production facilities (Le, 2023). Economic sustainability secured the least points (=170) points, which is surprising given that it is so crucial to the farmers, and the responses to the survey used in collecting data to generate model parameters have come from the farmers. A theoretical reason for this discrepancy could be that social sustainability overlaps with economic sustainability, as evidenced in Appendix 1 (e.g., higher quality of life resulting from farming will not eventuate unless the farmer is economically sustainable). Hence, it is suggested that all three TBL sustainability categories should be treated as mutually reinforcing PM categories.

### 7.5 Conclusion

Smallholder and, to some extent, medium-scale dairy farmers—common in the VC of developing countries—require support to improve their farm businesses and achieve sustainable outcomes. Milk processing companies, as buyers of farm produce in such contexts, have an incentive to develop their farmers to secure sustainable outcomes for both them and their farmers. By conceptualizing the phenomenon of "developing small and medium-scale dairy farmers by their milk processor to achieve farmer sustainability," this study developed an easy-to-use scoring system. This system can serve as an integral component of a PM system that milk processors can leverage to gain a competitive advantage. The study demonstrated how the scoring system could help milk processors focus on improving farmer performance and highlighted how the resulting PM system could enhance productivity, support CSR efforts, and bolster voluntary sustainability reporting. Aligning the PM constructs/categories with the SDGs ensures that well-executed farmer development programs position milk processors advantageously in the CSR and sustainability reporting landscape. While this study focused on milk processors leading farmer development, the findings are analytically generalizable to other buyer-led farmer development initiatives in developing countries, including those led by governments or large-scale vendors.

The paper contributes to the body of knowledge on farmer development and sustainable PM in agribusiness and operations management. Theoretical and practical implications were discussed, and the findings are also valuable for policymakers in developing countries. Policymakers can utilize KPI data from the PM measurement items maintained by milk processors (or other large-scale buyers) to identify gaps in policies aimed at farmer development. However, the study has limitations. First, data collected from farmers selected for training by their milk processors based on specific eligibility criteria. Second, the data represents only two main milk-producing regions of the country. Finally, the study was designed specifically for the Sri Lankan context. Future research should replicate this study in other developing countries with appropriate adaptations.

**Chapter 7, Appendix1: The 0-1000 scoring system for OVERL**

| Construct (PM Category) | PM Item Label | Item Description | Points |
|---|---|---|---|
| Farmer Capability (FC) (236 Points) | CAP1 | Practicing knowledge gained from training programs | 37 |
| | CAP2 | Maintaining service relationships | 65 |
| | CAP3 | Ability to supply milk year-round | 90 |
| | CAP4 | Conformance to milk quality specifications | 42 |
| Processor-Farmer Relationship (PFR) (180 Points) | Satisfaction* | Farmer's satisfaction on price received from milk, the net return received from supplying milk, and the frequency of two-way communication *(three sub items)* | 100 |
| | Trust* | Believing the processor for their: honest information and assistance when needed, business proficiency, and values *(four sub-items)* | 80 |
| Economic Sustainability (170 Points) | ECNSUS1 | Gross income received from dairy farming | 50 |
| | ECNSUS2 | Farming income being able to meet household needs | 64 |
| | ECNSUS3 | Overall Profitability of the farm business | 57 |
| Social Sustainability (223 Points) | SOCSUS1 | The quality of life resulting from farming | 90 |
| | SOCSUS2 | Being able to provide a good education to the children | 75 |
| | SOCSUS3 | Recognition received from the community for mutual help | 58 |
| Environmental Sustainability (190 Points) | ENVSUS1 | Proper disposal of the effluents | 50 |
| | ENVSUS2 | Use of solid waste for agriculture activities | 60 |
| | ENVSUS3 | Action to reduce air pollution | 80 |
| | | **TOTAL** | **1000** |

**Notes:**

(1) Since the items satisfaction and trust cannot be captured through a single statement in the questionnaire, three and four statements respectively were used in the questionnaire to capture these two sub-domains. The average scores of the sub-domains were used as the item scores to run the PLS-SEM algorithm.

(2) The point allocations shown in this table for each item can be easily converted into weights by dividing by 1,000 (e.g. the weight of CAP1 is 0.037, the weight of CAP 2 is 0.065, etc.)

The points each item should secure can be estimated using two methods—method 1 uses estimated item weights only, while method 2 uses a combination of regression weights and item weights—and both methods produce the same result, due to the way the model has been specified. As a specimen calculation, the allocation of 37 points for item CAP1 is shown below:

**Method 1 – Using the Item Weights Only (see the estimated weights shown in Figure 7.1)**

'The Contribution of the Sustainability Enablers' = 416 points (being 0.416*1000)

Therefore, points secured by CAP1 = w9* The Contribution of the Sustainability Enablers = 0.088*416 = 36.61 (rounded up to 37 points).

**Method 2 – Using a Combination of Item Weights and Regression Weights**

Since 'The Contribution of the Sustainability Enablers' secures 416 points, the category FC secures k1*'The Contribution of the Sustainability Enablers' = 0.567*416 = 236 points.

Therefore, points secured by CAP1 = w1* FC = 0.155*236 = 37 points (when rounded up).

# CHAPTER 8:
# FINAL DISCUSSION AND CONCLUSION

## 8.1 Introduction

This chapter presents an overall discussion and conclusion of the study. Section 8.2 demonstrates how the study achieved its objectives. Section 8.3 covers the implications of the findings from theory, practice, and policy angles. Section 8.4 covers the study's limitations. Section 8.5 suggests potential directions for further research, section 8.6 presents final thoughts about the study's contribution and finally section 8.7 concludes the study with a personal reflection on the PhD journey.

## 8.2 Research findings corresponding to the research objectives

The research objectives of the study were to: study the dairy VC of Sri Lanka to understand how farmer development takes place through a milk processor (RO1); develop and test a theoretical model that predicts and explains the relationship between processor-led farmer development initiatives, farmer capability, processor-farmer relationship, and sustainable farmer performance (RO2); analyze farmer heterogeneity to enable milk processors and other interested parties to better focus on farmer development initiatives (RO3); and, develop an index to measure the overall sustainable performance of dairy farmers and facilitate efficient, sustainability-focused development (RO4). While RO1 and RO2 focus on developing and testing a theoretical model to predict and explain the outcomes of farmer development, RO3 and RO4 focus more on enabling farmer development to be more efficient and effective.

Section 8.2 has been arranged to highlight the seamless progression among chapters (presented as papers), with each chapter building naturally on the conclusion of the preceding chapter.

### 8.2.1 Achievement of RO1

The thesis chapter that achieves RO1 is Chapter 4. To study the dairy VC of Sri Lanka to understand how farmer development takes place through a milk processor (RO1), an exploratory analysis of the Sri Lankan dairy VC was conducted by engaging with important actors—dairy farmers, milk processors, milk collecting centers, milk collectors, and senior officials and technical officers—in the form of interviews. This was to gain a comprehensive understanding of the context within which the theoretical model was tested subsequently. Sample selection for the interviews was based on the snowball sampling method, and the interviews were semi-structured. The interview guide and key questions are shown in Appendix

A through Appendix E. This exploration enabled the identification of the structure of the formal dairy VC (mapping the VC was part of this), governance (identifying the governing structure of the VC to a sufficient level to establish the position of large milk processors as focal companies), value flow through the VC, and understanding the role being played by a milk processor in developing dairy farmers in Sri Lanka.

The VC mapping identified the upstream actors (defined relative to the milk processor) and value flow in the formal dairy VC of Sri Lanka, including dairy farmers (predominantly smallholders, with a small portion of medium and large-scale farmers), milk processors (often managing their own milk collecting centers[23] in addition to running their milk-processing plants), and other intermediaries such as CSCCs, FMSCs, and individual intermediaries such as transporters and merchant intermediaries. The content analysis found that large milk processors hold significant power to govern the coordination, rule, and control of the process along the Sri Lankan dairy VC, cementing its position as the 'focal company' in the dairy VC. According to the literature (e.g., Harland, 1996; Mentzer et al., 2001; Seuring & Müller, 2008), a focal company's unique position of being able to govern, coordinate, and control the VC, places the company in a unique position to extend SD beyond just improving the suppliers' delivery and quality performance—plus any other supplier performance attribute sought—to addressing supplier sustainability (Seuring & Müller, 2008; Trienekens, 2011). Fieldwork found that large milk companies are trying to improve the economic, social, and environmental outcomes of their farmers.

The study then explored the specific farmer development initiatives implemented by milk processors. It was found that processors commonly provide farmer development (FD) support through three main categories of initiatives: farmer training (FT), financial support (FS), and evaluation and feedback on farmer quality performance (EFFQP). It was further discovered that through FD, large milk processors are justifiably expecting mutual benefits through relational transactions.

In summary, the above findings enabled the study to achieve RO1. The process used in achieving RO1 is concisely shown in Figure 8.1. As shown in Figure 8.1, certain contents in Chapters 2 and 3 feed into Chapter 4 to achieve RO1.

[23] Most milk collecting centers—all milk collecting centers owned by some milk processors—were found to be equipped with milk chilling facilities.

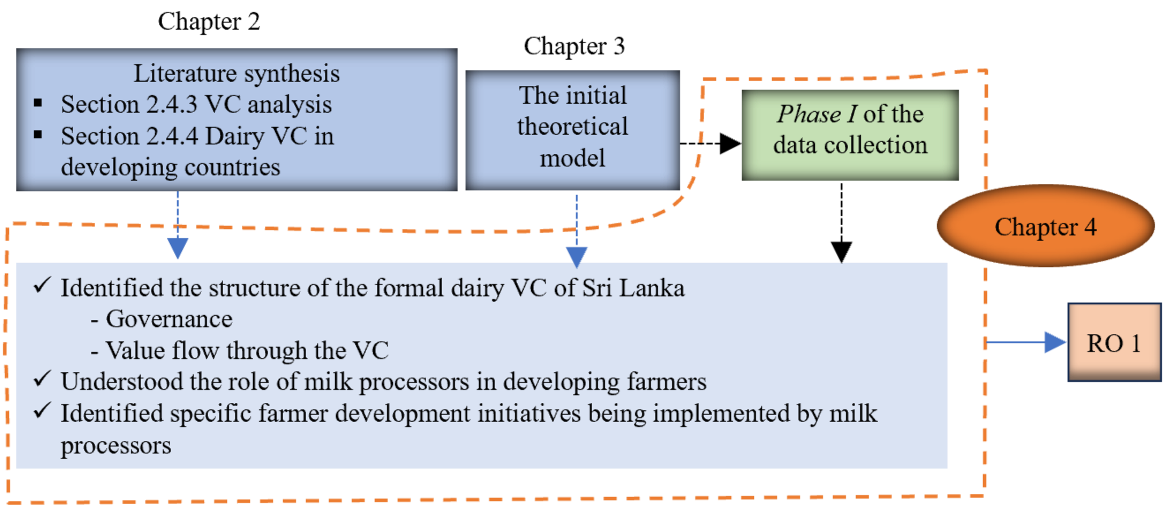



**Figure 8.1 Achievement of RO1**
*(Source: Own work)*

### 8.2.2 Achievement of RO2

The thesis chapter that achieves RO2 most is Chapter 5, but Chapter 3 does its fair share in achieving RO2, which is undeniably the most pivotal objective of the study. To achieve RO2—develop and test a theoretical model that predicts and explains the relationship between processor-led farmer development initiatives, farmer capability, processor-farmer relationship, and a farmer's sustainable performance—first, an initial theoretical framework was developed based on the literature (details in Chapter 3). This framework was further developed to become a testable theory model, which was indeed tested using data collected from 324 dairy farmers in Sri Lanka (details in Chapter 5).

In developing the initial theoretical model, the researcher used SD literature in operations and SCM to project farmer development as being conceptually analogous to SD, notwithstanding the differences between AVCs in developing countries and non-food VCs (Baumeister & Leary, 1997; Green et al., 2006; Hidayati et al., 2021; Neuman, 2013). Thus, chapter 3 covered an initial exploration to determine the working definitions for the constructs and the propositions that collectively explain how farmer development drives farmer capability (FC) and processor-farmer relationship (PFR) to result in sustainable farmer performance. The working definitions of the constructs provided by the researcher were based on a range of literature (e.g., Brix-Asala et al., 2021; Chopde et al., 2019; Lees et al., 2020; Moses et al., 2023; Nath et al., 2010; Pedroso et al., 2021; Sachitra & Chong, 2018; Thakur et al., 2022; Zanin et al., 2020). Similarly, the proportions were formulated based on a range of literature (e.g., Benton et al., 2020; Brix-Asala et al., 2021; Dlamini-Mazibuko et al., 2019; Glavee-Geo, 2019; Krause & Ellram, 1997;

Sachitra & Chong, 2018; Shukla et al., 2023; Wagner, 2009; Werff et al., 2018; Yawar & Seuring, 2020). Two management theories—the resource-based view (RBV) and the relational view—were used in proposition development. The RBV (Barney, 1991; Wernerfelt, 1984) was used to explain how a processor's valuable and inimitable resources can be leveraged to provide effective training and other forms of farmer support needed to improve farmer's value-creating capability—manifesting as improved product quality, improved farm output, long-term relationship formation for supply continuity—benefiting the farmer and enhancing the processor's competitive advantage. The relational view (Dyer & Singh, 1998) was used to justify the existence of a PFR. The takeaway from the work in Chapter 3 is the initial theoretical framework developed (Figure 3.2), which served as the platform to achieve RO2 through the work covered in Chapter 5.

In Chapter 5, a testable theoretical model was developed using sustainable supplier development (SSD) as the over-arching theme (Ağan et al., 2018; Bai & Satir, 2022; Cristina Sancha et al., 2015), which stems from the broader theme of sustainable supply chain management (Carter & Easton, 2011; Seuring & Müller, 2008). The testable model (Figure 5.1 in Chapter 5) contained three processor-led FD initiatives—FT, FS, and EFFQP—the mediators FC and PFR, and three sustainable farmer performance outcomes: economic sustainability (ES), social sustainability (SS), and environmental sustainability (EnvS). The operational definitions for the constructs were formulated in a questionnaire format (a range of literature was used), seeking responses from farmers, using Likert-type scales. Data collected from Sri Lankan dairy farmers—who are being trained by their milk processor—in the Nuwara Eliya and Kurunegala districts who supply milk to a large privately owned milk processor were used to test the model using the PLS-SEM technique, using SmartPLS 4 software.

Although not all the hypotheses that collectively represented the theoretical model were supported by data at a 0.05 significance level (See Figure 8.2 for the supported hypotheses), the core explanations offered via the theoretical model remained intact: (i) SSD does take place in the AVC context being studied, and (ii) FD initiatives drive sustainable farmer performance through the mediating variables FC and PFR (empirically speaking, PFR was more influential than FC). More specifically, FT was not found to affect either ES, SS, or EnvS at a 0.05 significance level[24]. The remaining two FD initiatives were found to affect all three sustainable

[24] The *P* values of the indirect effects FT→ES, FT→SS, and FT→ EnvS were greater than 0.05; they were less than 0.10, however.

farmer performance dimensions (i.e., ES, SS, and EnvS). Of the two influential FT initiatives, FS was found to be more influential than EFFQP in causing sustainable farmer performance.

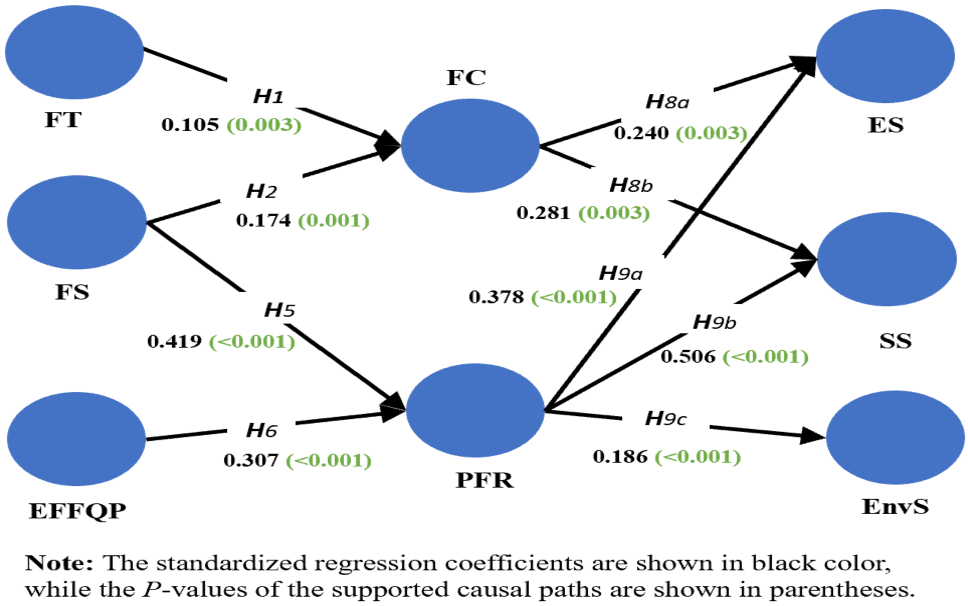



**Figure 8.2 Supported Hypothesis along with standard regression coefficient and *P*-value**
*(Source: Own work)*

The unsupported hypotheses as well as nonsignificant total indirect effects are shown in Table 8.1, with a concise statistical interpretation. The key takeaway from the results in Table 8.1 is that FT probably needs to be re-designed to have a sufficiently strong impact on FC, because currently, the effect is small, in terms of Cohen's $f^2$. This enhanced impact would then be transmitted to ES, SS, and EnvS through the hypothesized paths, ultimately enabling FT to influence sustainable farmer performance.

Interestingly, the findings also showed that on average, Kurunegala farmers are capable (e.g., can meet quality and delivery expectations of the milk processor) irrespective of the training level they receive, suggesting ineffective training, but Nuwara Eliya farmers are (on average) much less capable but do gain something from training, implying that farmer training needs to account for specific training requirements of a certain farmer group (Nuara Eliya and Kurunegala). Farmers can be reliably distinguished from one another based on type of cows being raised and farming method being used.

There is an incentive for the milk processor to re-design their training programs—at a very broad level, Nuwara Eliya farmers who farm exotic cows have different training needs than their counterparts in the low-country areas such as Kurunegala—based on the current analysis, gains of FC resulting from FT is small and this may not benefit the milk-processor in improving its own productivity, implying a very low return on training investment. The implications of the findings were discussed from theoretical, practical, and policy standpoints (Chapter 5), and some suggestions for improving FC and sustainable farmer performance were made. Towards its conclusion, Chapter 5 raised the challenge of developing different training programs, given the heterogenicity of farmers, which is what Chapter 6 covered in achieving the next research objective.

**Table 8.1 Unsupported hypotheses and total indirect effects**

| Unsupported hypothesis or the total indirect effect | Statistical interpretation |
|---|---|
| H3: EFFQP → FC | The relationship is only weakly supported by the data (*p*=0.056); at 0.05 level, evaluation and feedback on farmer's quality performance does not have an impact on farmer capacity. |
| H4: FT → PFR | The relationship is not supported by the data (*p*=0.466); farmer training does not have an impact on the processor-farmer relationship. |
| H7: FC → PFR | The relationship is only weakly supported by the data (*p*=0.079); at 0.05 level, farmer capability does not have an impact on the processor-farmer relationship. |
| H8c: FC → EnvS | The relationship is only weakly supported by the data (*p*=0.083); at 0.05 level, farmer capability does not have an impact on a farmer's environmental sustainability. |
| FT → ES<br>via all the mediating paths | This total indirect effect is only weakly supported by the data (*p*=0.065); at 0.05 level, FT does not have an impact on a farmer's economic sustainability. |
| FT → SS<br>via all the mediating paths | This total indirect effect is only weakly supported by the data (*p*=0.074); at 0.05 level, FT does not have an impact on a farmer's social sustainability. |
| FT → EnvS<br>via all the mediating paths | This total indirect effect is only weakly supported by the data (*p*=0.098); at 0.05 level, FT does not have an impact on a farmer's environmental sustainability. |

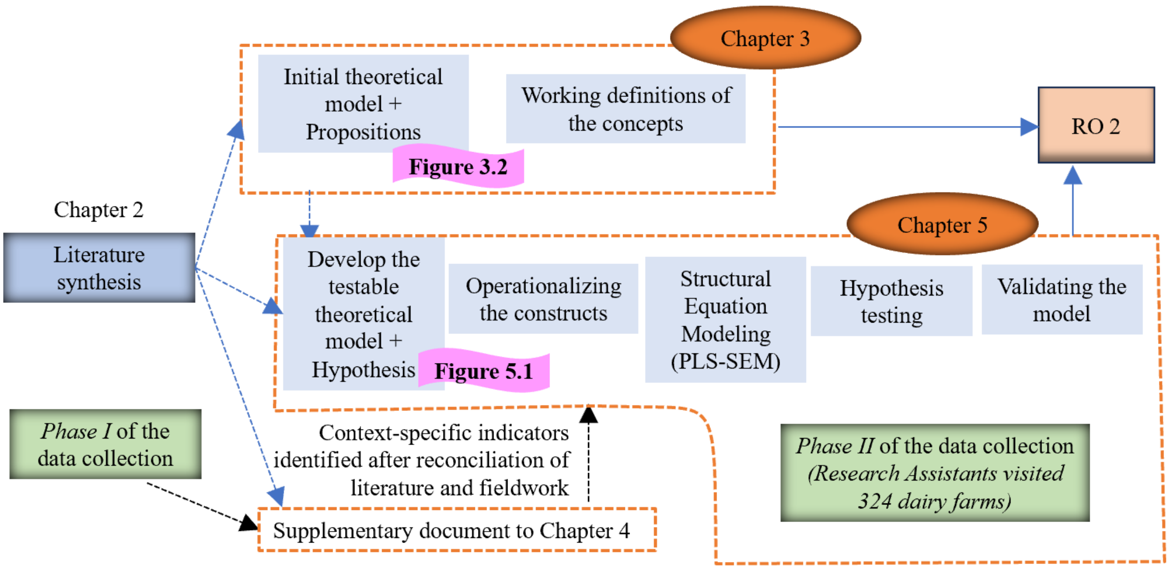



**Figure 8.3 Achievement of RO2**
*(Source: Own work)*

On the strength of the evidence provided, it is concluded that RO2 has been achieved successfully. The process used in achieving RO2 is concisely shown in Figure 8.3.

### 8.2.3 Achievement of RO3

The thesis chapter that achieves RO3 is Chapter 6. To achieve RO3—to analyze farmer heterogeneity to enable milk processors and other interested parties to better focus on farmer development initiatives—the empirical approach 'cluster analysis' was used[25] to assign the farmers (the 324 cases referred to in Chapter 5) into clusters (hence relatively homogeneous groups) using FC, PFR, ES, SS, and EnvS—the five constructs that represent farmer performance as holistically as possible—as cluster-forming variables. FC is the traditional notion of supplier (farmer) performance, which is reflected in this study by delivery performance, quality performance, performance in terms of applying knowledge acquired through training, and performance in terms of maintaining relationships with the supplier's stakeholders who provide training (the extension officers).  ES, SS, and EnvS (sustainable farmer performance or farmer's TBL performance) are also performance dimensions from a farmer's perspective because if they cannot improve on these dimensions, there will be no long-term progress. Besides, the notion of SSD makes ES, SS, and EnvS legitimate supplier (farmer)

[25] Cluster analysis was conducted using IBM SPSS Statistics V.29.

performance dimensions. The remaining construct PFR was considered a performance construct because it leads to sustainable farmer performance.

Three performance clusters were identified. The cluster that showed low mean scores[26] for the cluster-forming variables was named "Laggers" (e.g., mean FC = 2.19); the cluster that showed medium to medium-high mean scores for the cluster-forming variables was named "Accelerators" (e.g., mean FC = 3.91); finally, the cluster that showed high mean scores for the cluster forming variables was named "Leaders" (e.g., mean FC = 4.54). FC was found to be the most influential cluster-forming variable—by some margin—in providing the cohesion (closeness of scores with a cluster) and separation (distantness of scores between clusters) of the performance scores. An overall performance score was developed (based on the importance/influence of each cluster forming variable) to provide an easy-to-understand performance dashboard showing the performance range for each cluster. Figure 8.4 shows the distribution of the overall performance scores of the farmers within each cluster. The histograms also suggest decent cluster quality (no significant overlaps in the scores) in an easy-to-understand way. [27]

Having formed and named the clusters in an intuitively understandable way, as mentioned before the researcher went on to characterize the clusters using several evaluation variables: the three FD initiatives, two farmer characteristics, and eight farm/production characteristics. The analysis of the above evaluation fields resulted in a more straightforward cluster characterization and hence farmer typologies—95.6% of the Laggers were found to be farmers adopting intensive farming, and all the Nuwara Eliya farmers were found to be in this group. The Accelerators and Leaders were found adopting either semi-intensive or extensive farming and most of the Kurunegala farmers were found to be in this group. The cost of milk production was phenomenally high for Laggers (Mean = 32 US cents/L), compared to Accelerators (Mean = 18 US cents/L) and Leaders (Mean = 8 US cents/L). Other discrepancies also emerged and were discussed from a theoretical, practical, and policy standpoint.

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[26] The 1 (lowest possible score) and 5 (highest possible score) applies as the data are based on the 1-5 Likert type scale being used in the survey questionnaire.

[27] Silhouette measure reported by SPSS (≈ 0.50) indicates the quality of the clusters as number, but it is easier to obtain an approximate idea of the quality of the clusters via Figure 7.1.

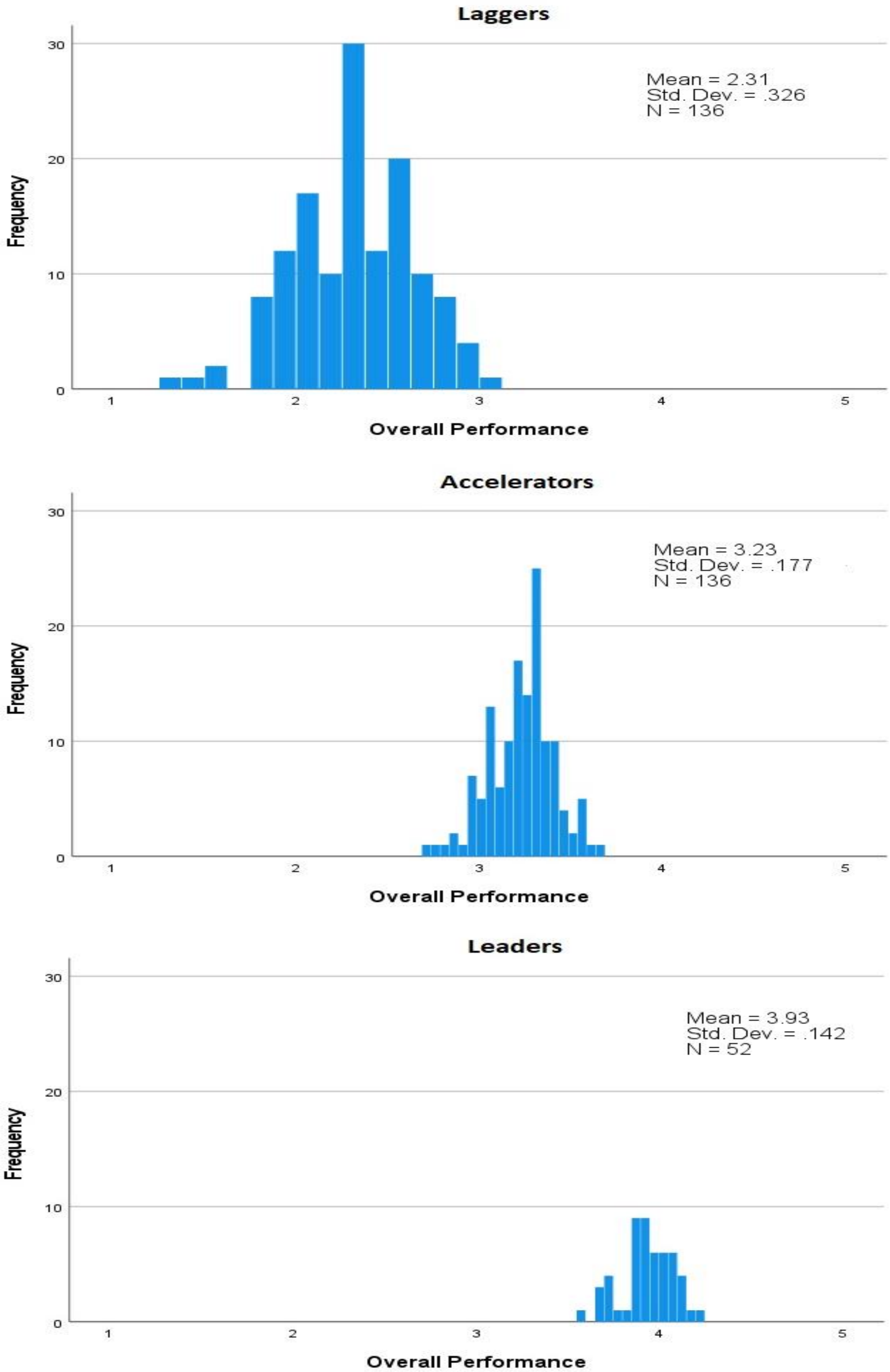



**Figure 8.4 The distribution of the overall performance scores of farmers in each cluster**
*(Source: Own work)*

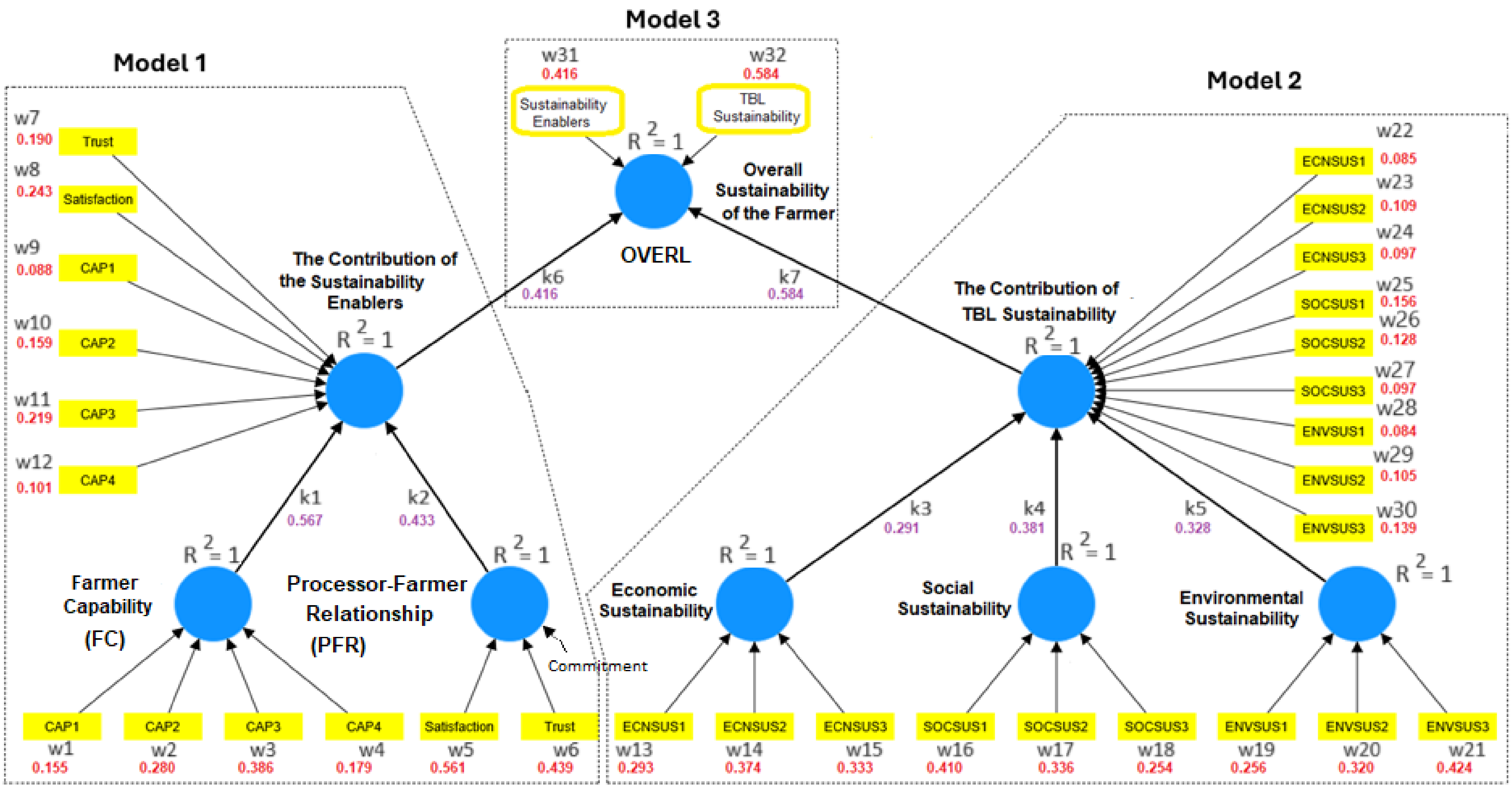
On the strength of the evidence provided, it is concluded that Chapter 6 achieved RO3.

### 8.2.4 Achievement of RO4

The thesis chapter that achieves RO4 is Chapter 7. To achieve RO4—to develop an index to measure the overall sustainable performance of dairy farmers and facilitate efficient, sustainability-focused development—an easy-to-use performance measurement system (more precisely a scoring system) was developed by specifying an index creating a model and fitting the data (collected for the study covered in Chapter 6) to the model in such a way that the model fitted to the data perfectly; the second-order formative-formative construct operationalization, within PLS-SEM (Crocetta et al., 2021) enabled the researcher to accomplish this.

In achieving RO4, the statistical model developed by the researcher combined multiple models to operationally define the sustainability index, for which the name "the index on the Overall Sustainable Performance of the Farmer (OVERL)" was coined.  For the convenience of the reader, the model with estimated parameters (valid for the 1-5 Likert type scale being used to collect data) shown in Chapter 7 has been reproduced as Figure 8.5. The constituents (items) of OVERL, consisting of five measurement areas (categories) and 15 subareas (items), were re-scaled to provide a 0-1000 score range for OVERL. The researcher argued that monitoring performance based on 15 key performance indicators (KPIs) is doable and is consistent with the numbers used in other performance measurement systems.

As shown in Figure 8.5, the model consisted of two second-order formative-formative constructs (operationalized through model 1 and model 2) which are combined through a third model (model 3) to ensure that the elements that formed the first second-order construct labeled 'the contribution of the sustainability enablers' and the elements that formed the second second-order construct labeled 'the contribution of TBL sustainability' have been weighted under a common platform having a 1-5 scale (the scale used in survey data collection). This 1-5 scale was re-scaled into a 0-1000 scoring system to align the scoring system with those used in performance excellence frameworks used in 'business excellence' (e.g., the Baldrige excellence framework), which is a niche area in operations management.



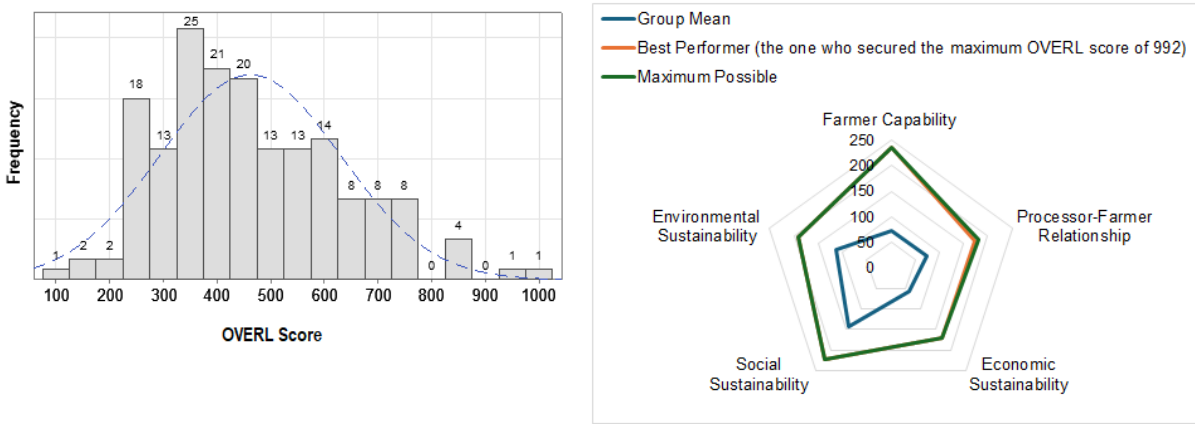

**Notes:** (1) w1 to w32 are indicator weights, while k1 to k7 are regression weights; (2) Commitment as a predictor of PFR was rejected by the data. Hence no weight was assigned to Commitment

**Figure 8.5 The fully parametrized model that generated the overall farmer sustainability index**
*(Source: Own work)*

The first second-order construct contained four elements belonging to FC (the same elements covered in Chapter 5) and two elements belonging to PFR (Satisfaction and Trust covered in Chapter 5)[28]. The second-second-order construct contained three elements belonging to ES (one more element than what was covered in Chapter 5), three elements belonging to SS (the same elements used in Chapter 5), and three elements belonging to EnvS (the same elements used in Chapter 5). Consequently, the overall farmer sustainability index contained five performance measurement categories and 15 items altogether. If only one KPI is sufficient to represent each item in the accompanying PM system, it was argued that monitoring 15 KPIs of the farmers under training—through an efficient information management system—is possible.

The researcher suggested two options where her index (OVERL) and its constituents could be used. The first option was to use OVERL as a single variable to group farmers across the board (i.e., group all farmers under training in all the districts the milk processor operates) to group farmers based on their OVERL scores (e.g., <Q1 group, Q1-Q3 group, >Q3 group) and design FD strategies that fit each performance group thus identified. The second option that the researcher promoted more ways to use OVERL and its constituents for farmer typologies that are known to the processor. The researcher found that farmers who use intensive farming on average perform poorly in the Sri Lankan context (something that should not happen under normal circumstances), relative to their counterparts in the semi-intensive farming and extensive farming groups. The researcher suggested how the milk-processing company might leverage their few high-performance farmers in the intensive farming group (see Panel 1 of Figure 8.6) to provide a more informal mentorship to the group. Using a radar chart (see Panel 2 of Figure 8.6), the researcher showed which areas (performance measurement categories) need to be addressed most, both from theoretical (based on the researcher's improvement theory) and practical (based on the researcher's estimated weights) standpoints.

[28] Interestingly the second order model did not accept 'Trust' as an element of PFR (Trust was accepted as an element of PFR in testing the theory on SSD). The reason for this discrepancy, from a statistical standpoint, is that PFR has been purposely modelled as a formative construct to align PFR index creation notion. PFR is about relationships; hence for theory testing purposes, as rightly done in Chapter 4, PFR should be modelled as a behavioural construct possessing psychometric properties.




Panel 1: Distribution of the OVERL score of the farmers following intensive farming

Panel 2: Per-category performance of the farmers following intensive farming

**Figure 8.6 The performance of the 172 farmers who adopted intensive farming**
*(Source: Own work)*

On the strength of the evidence provided, it is concluded that Chapter 7 achieved RO4.

## 8.3 Implications of the study

The theoretical, practical, and policy implications of the study are summarized in Table 8.2 to enable the reader to compare and contrast the studies (Chapters 3-7) in terms of their theoretical, practical, and policy contributions. However, in section 8.3.1 the theoretical contributions have been made clearer by aligning the theoretical implications (Table 8.2) with the key literature that represents the current body of knowledge.

**Table 8.2 Summary of research contributions**

| Chapter/Paper Heading | Contributions | | |
|---|---|---|---|
| | Theoretical | Practical | Policy |
| **Chapter 3:** Sustainable farmer development for agri-food supply chains in developing countries | A theoretical framework that conceptualized how direct and indirect forms of farmer development lead to sustainable farmer performance, in the form of propositions, which can be advanced to become testable hypotheses through specific contextualization and construct operationalization.<br><br>Helps positivist case researchers to design their fieldwork (related to the topic) before engaging with their key informants because the framework can serve as a guide to designing the interview protocols. Positivists/post-positivists invariably rely on some theoretical understanding of the phenomenon before the fact (Eisenhardt, 2021; Yin, 2018). | Helps the practitioners to think about the most critical direct and indirect farmer development initiatives and the distinction between the two forms of farmer development initiatives, from a viewpoint of supplier development.<br><br>Directs practitioner attention toward the three elements of the processor-farmer relationship, in a context where the processor happens to be the buyer; the three elements being trust, commitment, and satisfaction.<br><br>This creates curiosity among the practitioner community that there is a case for processors to get involved in developing the farmers. | |
| **Chapter 4:** Studying the dairy VC of Sri Lanka from the perspective of processor-led farmer development | Identified the key role being played by the milk processors in developing dairy farmers and the existence of three categories of FD initiatives in a Sri Lankan context. This encourages the Sri Lankan research fraternity to | The study assists practitioners (milk processors) in identifying their role in managing dairy farmers. | Guides policymakers to put systems in place (e.g., establishing milk quality and food safety standards) to motivate practitioners to take farmer development more seriously. |

| Chapter/Paper Heading | Contributions | | |
|---|---|---|---|
| | **Theoretical** | **Practical** | **Policy** |
| | design several different types of studies related to the findings. | | |
| **Chapter 5:** Supplier development to improve supplier sustainable performance: A test on a dairy supply chain of a developing country | Developed and tested a theoretical model that predicted and explained SSD in the context of a dairy VC in a developing country. The study led to designing more studies (two were conducted by the researcher), and more studies (e.g., studying regional effects more closely, studying the two-way interactions between farmer development initiatives such as FT*FS) could be conducted, based on the findings.<br><br>Applied the concept of SSD as understood in operations management to an AVC (dairy) in a developing country. | Showed that FT works in one region (Nuwara Eliya) in FC to a certain extent but not in the other region (Kurunegala). This coupled with the low impact of FT→ FC across the board (due to averaging out the effects corresponding to the two regions) may prompt milk processors to rethink and redesign their training programs.<br><br>The finding that financial support is indeed the most influential determinant of sustainable farmer performance (the TBL outcomes of the farmer) shows how important financial support is, in the current economic/social/political macroenvironment of Sri Lanka.<br><br>Showed that EFFQP has a very weak impact on FC ($p$ = 0.056), which may prompt the processor to rethink ways in which they could make EFFQP more effective. | Informed policymakers that FD should not be left almost entirely in the hands of the privately-owned processor for two reasons: (i) the processor uses strict criteria for selecting the right farmers for training, resulting in a reasonable proportion of smallholder farmers being left out (this is consistent with SD principles and in the opinion of the researcher, the processor is probably doing the right thing, from their point of view); and (ii) the weak FD initiatives→ FC links.<br><br>Shows ways policymakers could get involved in FD (e.g., through private-public-partnership, incentivization of milk processors for active involvement in FD). |

| Chapter/Paper Heading | Contributions | | |
|---|---|---|---|
| | Theoretical | Practical | Policy |
| **Chapter 6:** Exploring dairy farmer heterogeneity in a developing country to improve farmer performance through processor-led development programs | Used theoretically aligned factors (rather than principle components generated from an assortment of variables, which was found to be the method-of-choice) to form clusters—hence novelty—which simplified dairy farmer heterogeneity analysis and identification of the resulting farmer typologies by treating farmer performance constructs only to create the clusters, resulting in essentially farmer performance clusters (the clusters were of course characterized using several evaluation fields, including FT, FS, and EFFQP).<br><br>Used multidisciplinary research—operations management, benchmarking, agriculture, and data science—to provide a more balanced and holistic picture of how dairy farmer heterogenicity can be explored. | Identified a reliable way to assign a farmer to a specific performance cluster (e.g., lagger), so that the farmer would receive FD support that has been tailored to that specific cluster.<br><br>Found that the underperforming group (Laggers) was in a dire situation, as their production cost (32 US cents/L) equaled the price being paid for the milk—a stark contrast to the top performers, whose production cost was only 8 US cents/L.<br><br>Showed that even the better-performing farmer groups (i.e., Accelerators and Leaders) have room to improve, in terms of milk productivity; the findings tallied with farmer perceptions about their economic sustainability.<br><br>In summary, compelling evidence suggests that FD programs need to be re-designed to suit the characteristics of the farmers. | Informed policymakers of the need to put systems in place to provide farmer development support for farmers that milk processors cannot develop (in spite of being trained), in a market economy—for example, to do what is necessary to move bottom-tier Laggers (their overall performance ranged from 1~2.77 in the 1-5 scale) to Accelerators. |

| Chapter/Paper Heading | Contributions | | |
|---|---|---|---|
| | **Theoretical** | **Practical** | **Policy** |
| **Chapter 7:** Index to measure the overall sustainable performance of dairy farmers under buyer-initiated farmer development programs: A Sri Lankan study | Developed and tested an overall farmer sustainability index (OVERL) and an accompanying scoring system balancing pure empirical perspectives (e.g., multiple regression type analysis based on predictors thought to be predicting OVERL) with theoretical perspectives (a theory on processor-initiated FD) to get the best of both worlds. This balance brought novelty in creating the OVERL. | Demonstrated two ways the empirically validated index and its companying components (PM categories, items, and their weights) could be used to monitor farmer performance and guide the necessary action by the milk processor.<br><br>Showed how the index and its accompanying components may meaningfully contribute towards the milk processor's CSR and sustainability reporting.<br><br>The high empirical weight FC received emphasized how critical FC is, based on farmer perception (the data used came from the farmers) | Inform policymakers how they might liaise with a processor by obtaining the KPI data from the latter to identify policy gaps that might have to be bridged to better address farmer development. |

### 8.3.1 Contributions to theory

The study—which, as mentioned earlier, is a collection of five studies, attempted to address multiple knowledge gaps, and in doing so, made several theoretical contributions, which are described as follows:

#### 8.3.1.1 Role of milk processors in the dairy VC of Sri Lanka

Through Chapter 4, the study filled the lacuna that had been created due to limited descriptive studies on the fresh milk VC of Sri Lanka. Only four somewhat distantly related studies were found. While acknowledging the work of Kajananthan and Achchuthan (2012), which focused on VC analysis in a specific geographic area in Sri Lanka; Hitihamu et al. (2021), which emphasized VC analysis in terms of milk collection and production across some districts in Sri Lanka; and Vidanarachchi et al. (2019), which provided a generic overview of the VC, Priyashantha and Vidanarachchi (2024), which provides insights into the livestock industry in Sri Lanka and its ability to adapt to evolving circumstances, the researcher's study stood out as a study that offered a comprehensive description of the dairy VC in Sri Lanka, from an operations management perspective *(addressing Gap 3)*.

The study identified the structure of the formal dairy VC of Sri Lanka, its key actors, and the vital role being played by large milk processors as the focal companies—companies who hold the power to coordinate and govern SCs, establish rules and processes for upstream and downstream actors (Harland, 1996; Mentzer et al., 2001; Seuring & Müller, 2008). One such vital role that the large milk processors seem to be playing (based on the researcher's fieldwork) is developing the farmers, who are being recognized as suppliers.  These findings in Chapter 4 legitimized the title given by the researcher for her thesis: "A Supplier Development Framework for Agri-food Value Chains in Developing Counties: A Test on a Dairy VC in Sri Lanka".

Part of the researcher's review of the literature (Chapter 2) was focused on identifying who provides FD and how it is delivered. This search revealed only a limited number of studies addressing the role of processors (or similar actors) within an AVC in providing FD. Furthermore, these studies offered little insight into the specific FD initiatives implemented by processors (*knowledge gap 1*). The work presented in Chapters 4 and 5 addressed this gap by identifying specific farmer development (FD) initiatives implemented in the Sri Lankan context and objectively assessing their impact using positivist approaches, such as effect size analysis.

Thus Chapters 4 and 5 made a valuable contribution to theory. The major theoretical contributions of Chapter 5 and beyond follow.

8.3.1.2 Developing and testing a theoretical model to predict and explain the realization of supplier TBL outcomes through SD in an AVC

SD—activities a buying firm undertakes to improve the performance and capability of its suppliers—is a well-established concept within the realm of operations management and SCM, and a great deal of theory development has taken place over the years (e.g., Benton et al., 2020; Krause, 1997; Krause et al., 2007; Wagner, 2009; Yawar & Seuring, 2020). With the advancement of the theory base of SCM to cover sustainability, stretching the envelope of SCM to cover SSCM (e.g., Carter & Easton, 2011; Carter et al., 2020; Seuring et al., 2022; Seuring & Müller, 2008) provided pathways for SCM researchers to examine the extent to which SSD is taking place, from the angle of both the buyer angle and the supplier. However, the researcher found that although SD has been examined in AVCs in developing countries to some extent (e.g., Brix-Asala et al., 2021; Mukucha & Chari, 2021; Yawar & Kauppi, 2018), the same cannot be said about SSD at a theoretical level to predict and explain the phenomenon (*knowledge gap 2)*. The central argument of the researcher—based on the definition of SSD (Bai & Satir, 2022)—was that if SSD is taking place in an AVC, there must be a demonstrable causal relationship between SSD initiatives and sustainable supplier performance in that AVC. Addressing this knowledge gap 2 based on the researcher's central argument resulted in what the researcher considers to be her most significant theoretical contribution.

As in Chapter 3, the researcher developed a broad-spectrum/generic theoretical model to address knowledge gap 2, using the resource-based view (Barney, 1991; Hart, 1995; Wernerfelt, 1984), and the relational view (Blau, 1961; Dyer & Singh, 1998; Homans, 1958) as theoretical lenses. In this initial model, although the researcher considers the processor as the buyer who undertakes SD in the AVC, due to the generic nature of the model, the SD provider 'processor' can be replaced with any other buyer undertaking farmer development in a specific AVC (e.g., buyers of farmer produce under contract farming, farmer cooperatives etc.).

In the second stage of theory development (Chapter 5), the researcher contextualized her generic theory to become the model testable in the Sri Lankan dairy value chain. Consequently, after the initial fieldwork (Phase 1 of the data collection covered in Chapter 4), specific SD initiatives that were identified through fieldwork (also found in the literature) were used by the researcher as the cause (drivers) in her final theoretical model. In addition, the stakeholder theory (Donaldson & Preston, 1995; Freeman, 1984; Freeman et al., 2018; Harrison et al., 2019; Hörisch et al., 2014; Jones, 1995) was used as the overarching theoretical lens in presenting this final theoretical model, which is shown in Figure 8.7, with the theoretical lenses.

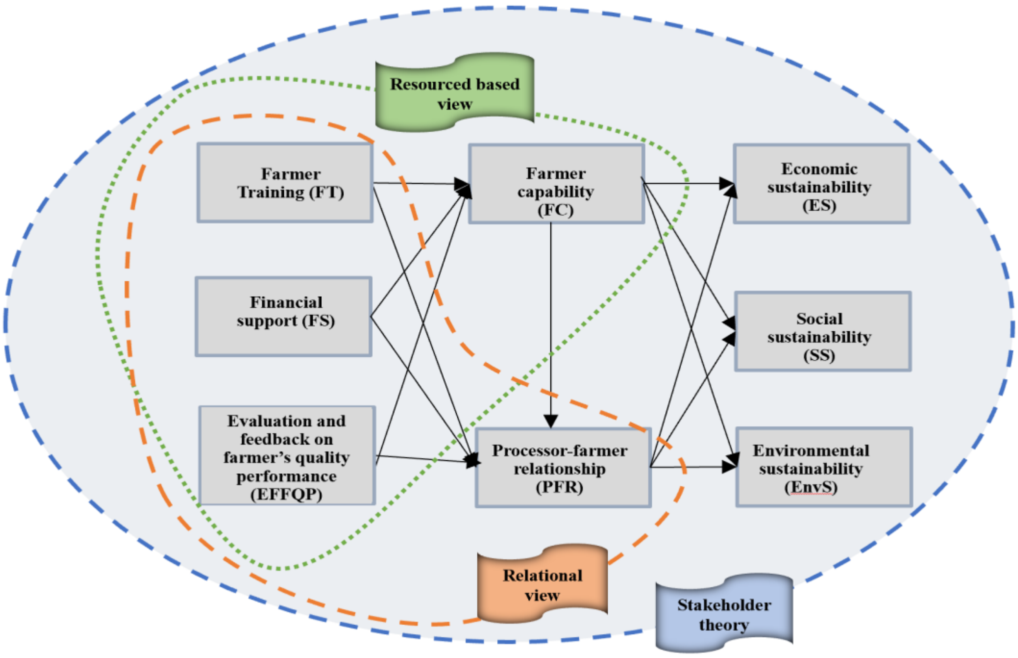



**Figure 8.7 The final theoretical model and the theoretical lenses used in the theorization**
*(Source: Own work)*

The findings added new knowledge to the current body of literature on SD and SSD related to predicting and explaining SSD and the researcher showed what happens to FC, PFR, ES, SS, and EnvS enhancements when a milk processor undertakes farmer development in a specific dairy VC.

The work covered in Chapter 6 also has the potential to make a theoretical contribution. Numerous studies on farm/farmer typology (or heterogeneity) analyses in developing countries have been published (most relevant ones were covered in Chapter 6), which range from the coverage of simple typologies (e.g., based on farm size) to more complex typologies identified through data science (e.g., PCA, cluster analysis). In Chapter 6, the researcher analyzed dairy farmer heterogeneity based on farmer performance (cluster variables being FC, PFR, ES, SS, and EnvS) to develop new typologies that may better facilitate performance improvement through benchmarking. This provides a novel theoretical perspective on farmer heterogeneity, contributing new knowledge to the existing literature on dairy farmer heterogeneity analysis—

particularly in the context of performance improvement for developing countries like Sri Lanka.

Finally, the researcher claims that the work covered in Chapter 7 also makes a theoretical contribution on the grounds that she designed a novel performance index to measure the overall sustainability of a farmer (OVERL), maintaining a good balance between a theoretical mindset (the researcher had a theory on performance improvement when she wanted to lean on to) and an empirical mindset (guessing a regression model of the form $Y = \Sigma\beta_i X_i$ and fit that model to the data to estimate $\beta_i$ parameters) to bring the best of both extremes.

## 8.4 Limitations of the study

### 8.4.1 Limitations resulting from selecting a single milk supplier and only two milk-producing districts

While using Sri Lanka is not a limitation of the study (Sri Lanka was the boundary of the study) limiting the study to a single milk processor and using farmers being trained by them in only two districts of Sri Lanka can impose generalizability issues.

Resources permitting, it would have been good if the researcher was able to cover multiple milk processors (buyers) that provide farmer training and covering the farmers in all the milk production districts of Sri Lanka to prepare the sampling frame to administer the survey, but doing this was not possible due to several practical reasons. The first reason was, it was deemed necessary to visit the farms to collect the data to avoid significant response bias, and covering/visiting all the milk production districts of Sri Lanka was impossible practically. The second reason was that it was difficult to prepare the sampling frame covering all the major milk producers because many did not want to provide the contact details of their farmers. Thirdly, the researcher wanted to recruit farmers who are being trained by their milk processors to ensure that the respondents selected have a living experience with the questions being covered in the questionnaire.

### 8.4.2 Use of two languages and the possibility of biasing the results

Translating the questionnaire into two languages and administering the Sinhala version to the majority of Sinhala-speaking farmers in the Kurunegala district, and the Tamil version to the majority of Tamil-speaking farmers in the Nuwara Eliya district could create some bias; a scholar can question whether Kurunegala vs Nuwara Eliya differences in FC reported in

Chapter 5, for example, is partially attributable to the differences in the two versions of the questionnaire that the researcher may not have picked up through the back translations.

### 8.4.3 Covid-19 pandemic and having to use four Research Assistants

The researcher was based in Sri Lanka during the first two years of her doctoral study (from August 2020 to September 2022), 19 months due to the closure of New Zealand's border during COVID-19 pandemic, and five months (after the borders were opened) due to a very personal reason. Although the plan was to complete the second phase of data collection (questionnaire administration in Kurunegala and Nuwara Eliya districts) within the first two years of the doctoral study, things did not pan out the way the researcher wanted. The second phase was postponed until after the researcher arrived in New Zealand and had all the boxes ticked before she could launch the survey. Due to an administrative reason concerning international students, it was not possible for the researcher to travel back to Sri Lanka to administer the survey on the farmers, by the researcher herself (with the help of a translator when the respondent's native language happens to be Tamil, rather than Sinhala). Although the deployment of four research assistants (RA) (two speaking Sinhala and two speaking Tamil as mentioned earlier) to collect data had the advantage of completing the data collection within a relatively short period, there was a possibility that some nonrandom variation could be present in the data (systematic error) if the RAs intervened unnecessarily during data collection.

To minimize systematic error, the RAs were trained by the researcher and instructed not to select response choices on behalf of farmers, even if a farmer struggled to choose a particular question in Part A of the questionnaire, which was not intended to be administered in interview form. Despite these measures and the researcher's trust in the RAs' due diligence, it is possible that RAs occasionally assisted some farmers in selecting their responses. Had the researcher been able to visit the farms, she could have observed the survey process directly, including how well each farmer was able to read and understand the questionnaire.

### 8.4.4 Milk processor's perspective not considered during the survey

The relationships between the three FD initiatives (FT, FS, and EFFQP) and the mediating variables FC and PFR are crucial in the researcher's theorization (see Figure 8.7). Since the data came from the farmers and not from the buyer (milk processor), one can always question the accuracy of the FT→ FC relationship which came under scrutiny (Chapter 5). The milk processor (specifically, the extension officers who engaged with the farmers) may possess FT and FC data that are (possibly) more accurate than those collected from the farmers. However, due to practical constraints, this data were not obtained, which imposes a limitation on the study.

### 8.4.5 Inherent limitations of self-administered surveys

The main part of the questionnaire (Part A) was self-administered (i.e., no direct assistance was provided to the farmers in responding to the survey) and in addition, the farmers answered all the questions by themselves based on their perception. For example, a farmer's perception of FC may differ from the FC assessed by the milk processor based on their records or an audit conducted by a third party.

Self-administered questionnaires have been criticized for being susceptible to common method bias (CMB), although the tests for CMB (Kock, 2015; Podsakoff et al., 2003) cleared the data being free from being contaminated with CMB, statistics cannot fully detect CMB (Conway & Lance, 2010; Fuller et al., 2016; Podsakoff et al., 2003). The constant presence of an RA at the site may have minimized CMB in the responses. However, the inherent limitations of self-administered surveys remain a potential limitation of the study.

## 8.5 Future research avenues

The following further research avenues are suggested.

Based on the work reported in Chapter 5, the following further research directions can be suggested.

- ✓ It is suggested that the study be repeated in other agri-food contexts ideally incorporating more objective judgments on FC (e.g., based on hard data available with the training provider, which in the researcher's case was the milk processor) and sustainable farmer performance, if the purpose of the research is to examine the effect of FD on sustainable farmer performance.
- ✓ The suggestion is to leave SSD theory testing aside and to move into the more direct approach of examining the relationship between FT (cause) and FC (effect); FS (cause) and FC (effect); EFFQP (cause) and FC (effect), plus the two-way interactions between the above three cause variables on FC using a single multiple regression model of the form: $FC = \beta_0 + \beta_1 FT + \beta_2 FS + \beta_3 EFFQP + \beta_{12} FT{*}FS + \beta_{23} FS{*}EFFQM + \beta_{13} FT{*}FFQFM$ (data perming, it is desirable to test a second model also, with the same predictors but FC being

replaced by PFR as the response). The reason for suggesting FC be brought into the limelight is that if a researcher narrows down their focus to testing the effect of FD—especially that of FT—on FC with hard data (if available with the buyer/processor), the effectiveness of FD on FC can be examined more closely. FC is the traditional yardstick of supplier performance. If a farmer can meet delivery targets, show superior quality performance, apply what they learn from training, and maintain a good service relationship, in other words, excel in FC, it can be inferred that the farmer can achieve sustainable performance. Besides, the link between FC and sustainable farmer performance could be significantly affected by the noise contained in ES and SS data, which is also a reason why testing the relationships may be confined to testing the effect of the three FD initiatives on FC (data permitting PFR also).

- ✓ The third suggestion is to conduct a longitudinal study under the right conditions. That is just before (or soon after) the intervention and monitoring of the progress farmers make on FC (data permitting PFR also) over a period. Within this design, qualitative data can also be used to add richness to the findings.

Based on the work reported in Chapter 6, a further research direction might be to replicate the analysis in a different dairy VC in a similar developing country to gain more insight. A similar suggestion is made regarding the work presented in Chapter 7. In this case, however, it is recommended that empirically determined weights be reconciled with weights derived from data collected from subject experts (e.g., through a focus group) to achieve a consensus on the final weights to be used in the OVERL index.

## 8.6 Final thoughts about the study's contribution

Combining the findings, it can be concluded that in Sri Lanka's fresh milk dairy VC, SD—in the form of FD by the milk processor through training, including training on sustainable farming practices—FS, and EFFQP appears to be taking place. FD aims to improve farmers' capabilities, enabling them to meet quality and delivery requirements, apply what they learn, and engage with extension officers. FD appears to (i) positively impact FC (i.e., increased FD correlates with increased FC) and (ii) positively impact sustainable farmer performance, as seen through the lens of the TBL framework. However, whether the milk processor is doing enough is not a judgment the researcher can make. Furthermore, since the research design is cross-sectional and therefore correlational by nature (i.e., there is no experimental or quasi-experimental manipulation of causal variables to examine their impact on effect variables), the findings provide a plausible explanation of observed patterns rather than definitive proof, which an experimental study could offer.

SD in Sri Lanka’s fresh milk VC was found to bear some resemblance to SD in traditional manufacturing (e.g., a manufacturing supplier providing parts to an original equipment manufacturer), in that the buyer (the milk processor) selects only a portion of suppliers (farmers) for training. In this study, selection criteria included farmers owning at least five milk-bearing cows and/or consistently supplying at least 20L of milk per day. However, key differences between the two contexts were observed. For example, (i) supplier selection—an important aspect of SD in the scene supplier selection drives SD and suppliers’ sustainable outcomes—does not occur in Sri Lanka’s dairy VC primarily due to supply-side shortages, and (ii) supply service contracts are informal and highly fluid, allowing farmers to withdraw from supplying milk at any time and switch to another processor at their discretion. Despite this flexibility, farmers appear to remain remarkably attached to their chosen milk processor.

The methodologies and tools developed through this research, as covered in Chapters 6 and 7, remain useful regardless of the extent to which farmers are being developed or which milk processor is involved. Thus, the researcher concludes that overall, the thesis made significant theoretical and practical contributions to the field of SCM.

## 8.7 A personal reflection on the PhD journey

Embarking on a PhD journey is often described as a unique and transformative experience—a move from the known to the unknown. For me, it has been a journey of discovery, perseverance, and growth, shaped by a mix of challenges and achievements that have left an indelible mark on both my professional and personal life.

When I began my PhD, my interest, which was shaped by my academic background and motivation to contribute to a field that bridges academic rigor with practical relevance, fueled my determination. Having witnessed firsthand the struggles of smallholder dairy farmers in developing economies coupled with my initial naivety in advanced research, I remained committed to exploring sustainable development solutions to empower farmers and improve the dairy VC performance. Over time, I came to realize that my goal was highly ambitious and that a PhD study in SCM is not about solving such a broad problem but about contributing to the discourse on my specific topic.

The road was not without its hurdles. Navigating through a vast body of literature, designing a robust methodology, and analyzing data were intellectually demanding tasks. Personal challenges added another layer of complexity. The COVID-19 pandemic, coupled with balancing research with family responsibilities, financial constraints, and moments of self-doubt, tested my resilience. Yet, these challenges taught me the value of perseverance, adaptability, and creative problem-solving.

Several milestones stand out as highlights of my PhD journey. Arriving in New Zealand itself was a major milestone, as I had to continue distance learning during the first two years of my study. Completing my survey with a sample of 324 farmers was a significant achievement, particularly as I conducted it remotely while based in New Zealand. Presenting my findings at three academic conferences and receiving constructive feedback from peers were moments of validation that boosted my confidence. Participating in the 3MT competition provided me with an opportunity to develop concise and impactful communication skills. Submitting five research papers to peer-reviewed journals and responding to reviewer comments further honed my skills. The comments and feedback I received during every progress meeting with my panel of supervisors continually motivated me and helped me see the light at the end of the tunnel. Each milestone not only marked progress but also reinforced my belief in the importance of my research.

Through this process, I gained far more than academic knowledge. I developed critical thinking, time management, and effective communication skills. Perhaps most importantly, I learned the value of resilience and self-belief. The PhD journey has transformed me into a more reflective and determined individual, ready to face future challenges with confidence.

As I near the completion of this journey, I am filled with gratitude and a sense of accomplishment. The experiences and insights gained during my PhD have not only prepared me for a career in academia but have also fueled my passion for making a difference in the lives of others. Reflecting on this journey, I am reminded of a quote: *"Success is not final, failure is not fatal: It is the courage to continue that counts."* My PhD has been a testament to this idea. Starting the PhD as a single unmarried individual and completing it as a parent to a two-year-old baby has not been without sleepless nights. To those considering or embarking on their own PhD journey, my advice is simple: Embrace the challenges, celebrate the small victories, and never lose sight of your purpose.

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# APPENDICES

## Appendix A: Interview guide and key questions–Senior officials and technical officers

**A model on sustainable supplier development in developing counties: A test on dairy value chains**

**Code 01:** Senior official and technical officers
**Respondent:** …. / 05

**Interview protocol: Opening**

1. Introduction
   (a) Self-introduction to the respondent
   (b) Title of the research study
2. Purpose of the interview
   (a) Investigates the formal dairy VC in Sri Lanka with a focus on mapping its structure
   (b) Identifying the key actors of dairy VC in Sri Lanka
   (c) Examine the role of milk processors in driving farmer development
3. Confidentiality and consent
   (a) Explanation of the expectation to hear about the respondent's experience, how confidentiality will be maintained and obtain recording permission.
   (b) Provide the information sheet and obtain a sign for the informed consent form
4. Structure of the interview
   (a) Interview time (60-90 minutes)
   (b) Interview process–section A to section C
5. Opening question

**Key questions:**

**Section A: Identity**

A1 In what area are you specialized in, about dairy production in Sri Lanka?
A2 How long have been in this position?
A3 Give me some details about your work experience (explore past and current experience).

**Section B: Context-specific**

B1 In your opinion, who are the major players in Sri Lanka's formal milk value chain? Justify your answer, covering each major player and the activities they perform.

B2 Do you think milk processors in Sri Lanka influence supply chain activities significantly? For example, in making decisions as to whether they should develop their dairy farmers' productivity? Explain as detailed as possible giving examples.

B3 In your opinion, what are the major constraints in developing the efficiency and effectiveness of the dairy value chain in Sri Lanka? Explain as detailed as possible.

B4 Regarding to the previous question, what remedies do you suggest?

**Section C: Concept related**

C1 If the milk processors are involved in farmer development, which company/companies provide the most meaningful farmer development in Sri Lanka?

C2 Considering a farmer as a business entity, can you explain what are the key attributes of a capable farmer?

C3* In your opinion, do you think that milk processing organizations in Sri Lanka maintain a reasonable working relationship with their farmers? Can you describe the nature and attributes of such relationships?

C4* Can you explain what actions are being taken by milk companies and farmers to result in a sustainable milk supply chain? A sustainable milk supply chain is a supply chain that ensures that the production, processing, and distribution of milk minimize environmental impact, support social equity, and maintain economic viability.

C5* In your opinion, currently, what actions and strategies implemented by milk processing companies lead to the improvement of the socioeconomic status (SES) of dairy farmers?

C6* In your opinion, currently, what actions and strategies implemented by milk processing companies lead to the improvement of the environmental performance of dairy farmers?

**Questions C3 to C6 were posed because the answer to question C1 was in the affirmative.*

**Additional information:**

1. Please let me know whether there is any important missing information that I need to know.
2. How do you feel about the interview session? please feel free to provide any suggestions.

**Interview protocol: Closing**

1. Request to follow up if needed any further clarification or follow up questions
2. Appreciation and next steps (Thank for time and information sharing, interest to provide summary of findings once its completed)
3. Closing the interview (Thank and provide the letter of appreciation)

**Appendix B: Interview guide and key questions–Milk processors**

**A model on sustainable supplier development in developing counties: A test on dairy value chain**

| |
|---|
| **Code 02:** Milk processor<br>**Respondent:** …. / 04 |

**Interview protocol: Opening**

1. Introduction
   (c) Self-introduction to the respondent
   (d) Title of the research study
2. Purpose of the interview
   (d) Investigates the formal dairy VC in Sri Lanka with a focus on mapping its structure
   (e) Identifying the key actors of dairy VC in Sri Lanka
   (f) Examine the role of milk processors in driving farmer development
3. Confidentiality and consent
   (c) Explanation of the expectation to hear about the respondent's experience, how confidentiality will be maintained, and obtain recording permission.
   (d) Provide the information sheet and obtain a sign for the informed consent form
4. Structure of the interview
   (c) Interview time (60-90 minutes)
   (d) Interview process–section A to section C
5. Opening question

**Key questions:**

**Identity (Respondent)**

A1 What is your designation in this company?
A2 How long have been in this position?
A3 Give me some details about your work experience.

**Context-specific**

A4 In which areas your farmers are located?
A5 Please disclose your product portfolio by sales or by milk volume being used.
A6 What is your percentage contribution to the total fresh milk supply of the country?
A7 What is the total designed capacity of your milk processing plants?
A8 Approximately how many dairy farms are supplying milk to you?
A9 Who are your milk suppliers? In what ways do you buy milk for your farmers?
A10 Can you explain how you pay your farmers?
Please indicate who is involved in the process and at what stage.
A11 What specific quality/conformity checks/tests do you conduct when you accept milk for processing? Please describe at what stage of the milk value chain these quality/conformity checks/tests are being conducted.

A12 When a sample of milk fails to pass critical quality checks at your factory, how would you handle the batch from which the sample is drawn? Do you reject the whole batch, based on a specific criterion, as done in acceptance sampling? Also, how would you trace back to a particular farmer(s) who may have contributed to nonconforming results? Please describe the process.

A13 In your dairy business, who are your key stakeholders?

A14 What specific business challenges do you face in achieving your business targets related to dairy?

**Concept related (farmer)**

B1 What support do you provide to your farmers to improve their business? Describe as much as possible.

B2 What are the important capability areas that you aim to develop through your farmer development activities or programs?

B3 How would you prioritize and target your farmer development initiatives?

B4 What generic strategies do you implement to improve the performance and capability of your suppliers? Please rank them in order of importance.

B5 What specific farmer development initiatives do you implement to improve the performance and capability of your smallholder, medium scale and large-scale farmers?

B6 What specific improvements do you expect from the farmers by implementing your farmer development initiatives? Please consider multiple aspects of improvements in farmer capabilities.

B7 Describe how your relationships with the dairy farmers manifest (appear) to an outside observer. Consider different facets of this relationship when you elaborate on your answer.

B8 What are your realistic expectations of your farmer's economic, outcomes improvement, as a result of your farmer development initiatives? Also, how do you know that your farmers are achieving these outcomes?

B9 What are your realistic expectations of your farmer's social, outcomes improvement, as a result of your farmer development initiatives? Also, how do you know that your farmers are achieving these outcomes?

B10 What are your realistic expectations of your farmer's environmental outcomes improvement, as a result of your farmer development initiatives? Also, how do you know that your farmers are achieving these outcomes?

**Concept related (processor benefits)**

C1 What specific business outcomes do you expect in your business, as a result of your farmer development initiatives?

C2 How successful have you been in achieving the intended outcomes of supplier development and supplier relations strategies?

C3 Reflecting upon the experience your company have had in developing your farmers and establishing relationships with them, do you have anything else to comment on, such as barriers and constraints that are beyond your control?

**Additional information:**

1. Please let me know whether there is any important missing information that I need to know.
2. How do you feel about the interview session? please feel free to provide any suggestions.

**Interview protocol: Closing**

1. Request to follow up if needed any further clarification or follow-up questions
2. Appreciation and next steps (Thank you for your time and information sharing, and interest in providing a summary of findings once it is completed)
3. Closing the interview (Thank and provide the letter of appreciation)

**Appendix C: Interview guide and key questions– Dairy farmers (small and medium scale)**

**A model on sustainable supplier development in developing counties: A test on dairy value chains**

| | |
|---|---|
| **Code 03:** Dairy farmers | |
| **Respondent:** …. / 11 | |

**Interview protocol: Opening**

1. Introduction
   (e) Self-introduction to the respondent
   (f) Title of the research study
2. Purpose of the interview
   (g) Investigates the formal dairy VC in Sri Lanka with a focus on mapping its structure
   (h) Identifying the key actors of dairy VC in Sri Lanka
   (i) Examine the role of milk processors in driving farmer development
3. Confidentiality and consent
   (e) Explanation of the expectation to hear about the respondent's experience, how confidentiality will be maintained and obtain recording permission.
   (f) Provide the information sheet and obtain a sign for the informed consent form
4. Structure of the interview
   (e) Interview time (60-90 minutes)
   (f) Interview process–section A to section B
5. Opening question

**Key questions:**

**Farmer characteristics**

| | |
|---|---|
| A1 | How old are you? |
| A2 | Gender (to be noted by the researcher) |
| A3 | How long have you attended school? |
| A4 | How long have you been doing dairy farming? |
| A5 | Have you received any vocational training in dairy farming? If yes, can you briefly explain? |
| A6 | Why do you select dairy farming as your vocation? |

**Farm characteristics**

| | |
|---|---|
| A7 | Location of the farm (to be noted by the researcher) |
| A8 | Peri-urban Vs Rual (to be noted by the researcher) |
| A9 | Farm management system (to be noted by the researcher) |
| A10 | Does dairy farming is your primary source of income? |
| A11 | What are your other permanent income sources? |
| A12 | What is the approximate percentage contribution of dairy farming towards your annual household income? |

A13 What is farm size (heard size)?
A14 What is the average milk production from your farm?
A15 How long do your cows lactate in a good year?
A16 What proportion of your farm milk production is being used by you for domestic consumption?
A17 Apart from selling milk, in what other ways do you earn an income from your dairy farming activities?
A18 Apart from selling milk, do you sell any other agricultural products?
A19 Where do you sell your milk, and why have you selected that option?
A20 What price do you get for the milk for your milk?
A21 Can you explain how the milk you draw from the cows get collected, and how you get paid for the milk collected?
A22 What quality assurance checks do you follow to ensure that you maintain the quality of your milk until you hand over to milk collector?
A23 Are you planning to continue farming in the next 2-3 years?
A24 Are you planning to change your buyers/processors in the next 2-3 years?
A25 What major challenges do you face in improving your output and business results?

**Concept related**

B1 Do you as a farmer receive adequate support from your processor to run your business? Elaborate your answer.
B2 What assistance/support do you get from the dairy company that buys your milk?
B3 Who are the other players you think are important to your business? Explain why each player is important and what support they provide.
B4 Describe as vividly as possible, what your relationship with the milk company looks like.
B5 Are you satisfied with the income you receive from your dairy farming activities, as well as the profit you earn? Please describe as distinctly as possible. Other than your gross income and net income from farming, is there anything else that is important to you when you think of income-related achievements?
B6 What are your household's social expectations from dairy farming activity? Please describe as distinctly as possible.
B7 Are you adopting environmentally sustainable farming practices? Please describe as distinctly as possible.

**Additional information:**

1. Please let me know whether there is any important missing information that I need to know.
2. How do you feel about the interview session? please feel free to provide any suggestions

**Interview protocol: Closing**

1. Request to follow up if needed any further clarification or follow-up questions
2. Appreciation and next steps (Thank you for your time and information sharing, and interest in providing a summary of findings once it is completed)
3. Closing the interview (Thank and provide the letter of appreciation)

**Appendix D: Interview guide and key questions – Dairy farmers (large scale)**

**A model on sustainable supplier development in developing counties: A test on dairy value chains**

| |
|---|
| **Code 04:** Dairy farmer (large scale)<br>**Respondent:** …. / 01 |

**Interview protocol: Opening**

1. Introduction
   (g) Self-introduction to the respondent
   (h) Title of the research study
2. Purpose of the interview
   (j) Investigates the formal dairy VC in Sri Lanka with a focus on mapping its structure
   (k) Identifying the key actors of dairy VC in Sri Lanka
   (l) Examine the role of milk processors in driving farmer development
3. Confidentiality and consent
   (g) Explanation of the expectation to hear about the respondent's experience, how confidentiality will be maintained and obtain recording permission.
   (h) Provide the information sheet and obtain a sign for the informed consent form
4. Structure of the interview
   (g) Interview time (60-90 minutes)
   (h) Interview process–section A to section C
5. Opening question

**Key questions:**

**Identity (Respondent)**

A1 What is your designation in this company?
A2 How long have been in this position?
A3 Give me some details about your work experience.

**Farm Characteristics**

A4 Location of the farm (to be noted by the researcher)
A5 what is your farm size (herd size)?
A6 What is the average milk production from your farm?
A7 Can you describe the key farm operations taking place within your dairy farm that result in the production and supply of milk to the milk company?
A8 Now consider farm operations in a small dairy farm (5 cows or less). Can you revise the key processes about a small dairy farm, based on your experience?
A9 Can you explain what happened to your milk from the time you drew milk from the cow, up until it was used by the milk processing plant?
A10 Now consider farm operations in a small dairy farm (5 cows or less). Based on your experience can you explain what happen to their milk from the time they draw milk from the cow, up until it used by the milk processing plant.

A11 How do you collect your milk and how does milk gets conveyed to the milk possessing plant eventually?

A12 Can you explain me how the payment procedure takes place between you and the processing plant? Who else is involved in the process between you (the large farm) and milk processing company (buyer) in this payment process?

A13 What specific quality/conformity checks/tests do you conduct for milk that you produce?

A14 On average, what percentage of milk fail to pass your quality/conformity checks?

A15 In your dairy farming operations, who are your key stakeholders?

A16 According to your view what are the main challenges being faced by a dairy farmer of your size?

A17 Now consider farm operations in a small dairy farm (5 cows or less). According to your view what are the main challenges being faced by a small-scale dairy farmer?

**Concept related**

B1 Do you think that milk processing companies in Sri Lanka take initiatives to develop the capability/performance of their milk suppliers, namely farmers? **If yes,** can you describe the farmer development initiatives that you know of?

B2 What specific farmer development initiatives do you implement to improve the performance and capability of your smallholder, medium scale and large-scale farmers?

B3 In your opinion, other than milk processing companies (they pay money for the milk supplied), who else does take action to improve the capability of the milk farmers?

B4 According to your view, what are the key attributes of a capable farmer?

B5 In your opinion, do you think that milk processing organizations in Sri Lanka maintain a reasonable working relationship with their farmers? Can you describe the nature and attributes of such relationships?

B6 In your opinion, what actions and strategies taken/implemented by milk processing companies lead to improvements in the farmer's economic, social, and possibly environmental outcomes, as a result of farmer development initiatives?

**Additional information:**

1. Please let me know whether there is any important missing information that I need to know.
2. How do you feel about the interview session please feel free to provide any suggestions

**Interview protocol: Closing**

1. Request to follow up if needed any further clarification or follow-up questions
2. Appreciation and next steps (Thank you for your time and information sharing, and interest in providing a summary of findings once it is completed)
3. Closing the interview (Thank and provide the letter of appreciation)

**Appendix E: Interview guide and key questions – Milk collectors**

**A model on sustainable supplier development in developing counties: A test on dairy value chains**

| |
|---|
| **Code 05:** Milk collectors<br>**Respondent:** …. / 06 |

**Interview protocol: Opening**

1. Introduction
   (i) Self-introduction to the respondent
   (j) Title of the research study
2. Purpose of the interview
   (m) Investigates the formal dairy VC in Sri Lanka with a focus on mapping its structure
   (n) Identifying the key actors of dairy VC in Sri Lanka
   (o) Examine the role of milk processors in driving farmer development
3. Confidentiality and consent
   (i) Explanation of the expectation to hear about the respondent's experience, how confidentiality will be maintained and obtain recording permission.
   (j) Provide the information sheet and obtain a sign for the informed consent form
4. Structure of the interview
   (i) Interview time (60-90 minutes)
   (j) Interview process–section A to section C
5. Opening question

**Key questions:**

**Identity**

A1 How old are you?
A2 Gender (to be noted by the researcher)
A3 How long have you attended school?
A4 How long have you been involving milk collecting?

**Context related**

A5 Is milk collection your primary source of income? If milk collection is not your primary source of income, what is it?
A6 To which milk collection center are you affiliated to?
A7 To which milk company/companies do you supply milk through your collection cente
A8 What is the nature of your employment?
A9 Can you explain how you collect milk from farmers, and how you get paid for the quantities supply to milk processing companies. Explain the process as detailed as possible indicating who are involved in the process and at what stage.
A10 How many days a year do you collect milk?
A11 How many farmers do you reach to collect milk on a typical day?
A12 How many times a day do you visit a farm to collect milk?
A13 How many Liters of milk do you collect daily?

A14 How do you transport the milk that you collect?
A15 Where do you drop off the milk that you collect from the farmer?
A16 Does your milk collection center have milk chilling facilities?
A17 What are the shortest and longest times you take to deliver milk to where you are contractually obliged to deliver?

**Concept related**

B1 In your interactions with the farmers, are you been treated just as a third-party agent and thus being treated accordingly, or are you being treated more as an integral part of the farmers' social system?
B2 Describe the nature of the social interaction you have with milk farmers.
B3 As a milk collector, what major changes have you seen over the past ten years in farming, milking, and milk storage facilities?
B4 Describe the nature of your relationship with the milk collection center, be it owned by a farmer corporative or a milk company.
B5 Do you have a particular working relationship with the milk company? If so, what is that relationship? Please describe.
B6 As a milk collector, what are the major challenges that you face currently in improving your performance and income?
B7 What quality assurance steps do you follow to ensure that you do not compromise the quality of the milk handed over to you by the farmers?

**Additional information:**

1. Please let me know whether there is any important missing information that I need to know.
2. How do you feel about the interview session and please feel free to provide any suggestions

**Interview protocol: Closing**

1. Request to follow up if needed any further clarification or follow-up questions
2. Appreciation and next steps (Thank you for your time and information sharing, and interest in providing a summary of findings once it is completed)
3. Closing the interview (Thank and provide the letter of appreciation)

## Appendix F: Survey questionnaire (English)

MASSEY UNIVERSITY
COLLEGE OF SCIENCES
TE WĀHANGA PŪTAIAO

Respondent No.: …….

### The Survey Questionnaire for Dairy Farmers in Sri Lanka

Thank you very much for agreeing to participate in this interview — the "informed consent" which I obtained from you as required by the research protocols adopted by Massey University New Zealand. This is again a reassurance that I will not disclose any personal information in my thesis and all information provided by you will be handled with utmost confidentiality. (Please read this to the farmer)

**Supplementary Form**

Note to the Researcher:
This form includes selected questions that can be answered by the researcher. This form carries farmer screening questions and some demographic questions about the farmer. The researcher may ask the questions and also use his own observations, GPS locations, maps, and records at farms in answering the questions in this form. The researcher must attach this to the survey questionnaire.

**Screening questions:**
**(**Please read the following questions to the farmer and tick the correct answer given by the farmer)

1. Does the farmer sell more than 75% of milk to one milk processor? □ Yes □ No
2. Does the farmer deal with only one main/key milk processor? □ Yes □ No
3. Does the farmer get more than 60% of income from dairy farming? □ Yes □ No
4. Does the farmer have ≥5 cows in the farm or produce ≥20L per day □ Yes □ No

Note to the Researcher:
If, the farmer answered "**NO**" to any of the above questions (Q1, Q2, Q3 or Q4) researcher must thank the farmer and discontinue filling the rest of the questionnaire.

**Farmer's Information:**
(Please read the following questions to the farmer and write the correct answer given by the farmer)

5. Date of survey: ………../………/2023
6. Name of the respondent (for office purposes only): …………………………………………………
7. Age of the respondent: …………… years
8. Respondent's years of schooling ………… years
9. Respondent's gender (to be noted by the researcher): □Male □Female
10. GPS location of the farm: …………………………… (City/District)

***For Office Use Only:***

1. *Introduction of the researcher (Sinhala and Tamil translation where relevant) completed: □ Yes*
2. *Informed consent obtained: □ Yes*
3. *Other field notes:*

## Main Questionnaire–Part A

(Please give Part A of the questionnaire to the dairy farmer to answer. Only if the farmer requests you to read the question for them, please read and tick the appropriate answer).

*Please provide answers to the following questions about the organizations to which you are supplying milk.*

A.1 Where/to whom do you sell your milk? (Please write the answer as a percentage)

……. % at the farm gate
……. % to a milk collector
……. % to a processor
……. % any other (please specify) …………………………………

A.2 Please answer the following questions about your milk processing organization/organizations where you sell your milk as mentioned in A. 1 above.

| Company | Starting year | Volume supplied (*l*/day) | Avg. price per *l* of milk |
|---|---|---|---|
| 1. …………… | …………… | …………… | LKR: …………… |
| 2. Other …………… | …………… | …………… | LKR: …………… |

*The following questions are about the development support you receive from your milk processor, the relationship you maintain with your milk processor, and how those have improved your capability and your performance. Please answer the following questions thinking about the main milk processor that you are currently working with.*

A.3 For each of the statements below about development support received from your milk processor, please mark (x) your level of agreement or disagreement using Strongly Disagree (SDA), Disagree (DA), Neither Agree nor Disagree (NAND), Agree (A) and Strongly agree (SA).

| *Do you think your milk processor …* | | SDA | DA | NAND | A | SA |
|---|---|---|---|---|---|---|
| A.3.1 | Provides sufficient training on how to increase milk production | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.2 | Provides sufficient training in animal health and care (e.g., shading for cows, 24 hours water for animal etc.) | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.3 | Provides sufficient training on improving milk quality | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.4 | Provides sufficient training in farm business management | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.5 | Provides sufficient training on sustainable farming practices | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.6 | Provides loans to improve my dairy business | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.7 | Provides financial support to purchase dairy equipment | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.8 | Provides financial support during hardship | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.9 | Provides animal feed at reduced prices | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.10 | Provides animal feed on a credit basis | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.11 | Arranges third-party animal health and welfare services | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.12 | Offers a better price for high-quality milk | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.13 | Makes timely payments | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.14 | Share information on milk quality improvement methods | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.15 | Has an efficient platform to share my milk quality information for transparency | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.16 | Provides timely feedback on milk quality issues | ☐ | ☐ | ☐ | ☐ | ☐ |

A.4 Please specify if you receive any development support from your milk processor other than the one mentioned above.

…………………………………………………………………………………………………………………
…………………………………………………………………………………………………………………
…….

A.5 Are you a member of any development project of your milk processing organization? □ Yes □ No

A.6 For each of the statements below, please mark (x) on one of the five possible response options that best reflect your view on the relationship between you and your milk processor using Strongly Disagree (SDA), Disagree (DA), Neither Agree nor Disagree (NAND), Agree (A), and Strongly agree (SA).

| *You are …* | | SDA | DA | NAND | A | SA |
|---|---|---|---|---|---|---|
| A.6.1 | Satisfied with the price paid by your milk processor | □ | □ | □ | □ | □ |
| A.6.2 | Satisfied with the net return received from supplying milk to your milk processor | □ | □ | □ | □ | □ |
| A.6.3 | Satisfied with the frequency of two-way communication you are having with your milk processor | □ | □ | □ | □ | □ |
| A.6.4 | Believing that your milk processor provides you with honest information that is important to your business (e.g. maintaining accurate records of milk quality and payments) | □ | □ | □ | □ | □ |
| A.6.5 | Believing that you can rely upon your milk processor for assistance when needed | □ | □ | □ | □ | □ |
| A.6.6 | Liking the values of your milk processor upholds in business relationships with you. | □ | □ | □ | □ | □ |
| A.6.7 | Believing that your milk processor's proficiency in doing business with you | □ | □ | □ | □ | □ |
| A.6.8 | Feeling committed to supplying milk to your milk processor for the next two years | □ | □ | □ | □ | □ |
| A.6.9 | Willing to make changes to your farm to better meet your processor's requirements | □ | □ | □ | □ | □ |
| A.6.10 | Proud to be a supplier of your milk processor | □ | □ | □ | □ | □ |

A.7 For each of the statements below, please mark (x) on one of the five possible response options that best reflect your view on your social, environmental, and economic performance using Strongly Disagree (SDA), Disagree (DA), Neither Agree nor Disagree (NAND), Agree (A), and Strongly agree (SA).

| *You are…* | | SDA | DA | NAND | A | SA |
|---|---|---|---|---|---|---|
| A.7.1 | Satisfied with the gross income received from dairy farming | □ | □ | □ | □ | □ |
| A.7.2 | Satisfied that the income you receive from farming meets your household needs | □ | □ | □ | □ | □ |
| A.7.3 | satisfied with the overall profitability received from dairy farming | □ | □ | □ | □ | □ |
| A.7.4 | Satisfied with the quality of life that has resulted from dairy farming | □ | □ | □ | □ | □ |
| A.7.5 | Satisfied with the quality of education that your children receive | □ | □ | □ | □ | □ |
| A.7.6 | satisfied with the recognition you receive from the community due to interactive farming activities | □ | □ | □ | □ | □ |
| A.7.7 | Do not have a formal system to dispose of the effluents | □ | □ | □ | □ | □ |
| A.7.8 | Use solid waste for agricultural activities (selling or giving free to fellow farmers is also acceptable) | □ | □ | □ | □ | □ |
| A.7.9 | You do not have a specific plan to reduce air pollution (Consider the following, and provide an overall response: regular clearing of the cattle shed, composting manure and using covered storage facilities, adjusting feed rations to match the nutritional needs of cows, using easy-to-digest locally available feed crops) | □ | □ | □ | □ | □ |

A.8 For each of the statements below, please rate (x) your capability on the following aspects using Very Low (VL), Low (L), Neither Low nor High (NLNH), High (H) and Very High (VH).

| *You…* | | VL | L | NLNH | H | VH |
|---|---|---|---|---|---|---|
| A.8.1 | Can practice what learned via training provided by my milk company | ◻ | ◻ | ◻ | ◻ | ◻ |
| A.8.2 | Can maintain close relationships with extension service officers | ◻ | ◻ | ◻ | ◻ | ◻ |
| A.8.3 | Can supply the milk quantity my milk processor expects year-round | ◻ | ◻ | ◻ | ◻ | ◻ |
| A.8.4 | Can satisfy milk quality specifications | ◻ | ◻ | ◻ | ◻ | ◻ |

## Main Questionnaire–Part B

(Please read the following questions to the farmer and write the correct answer given by the farmer)

*Please provide answers to the following questions about your milk processor, dairy farm production, milk processing organization, farm practices and challenges.*

B.1 How long have you been in dairy farming? ………… years

B.2 What is your farm size? …………………… perches

B.3 What is your herd size? ………… cows *(Local breed ……. + Imported breed …… + Cross breed ………)*

B.4 What is the farm management system you use?
◻ (a). Intensive
◻ (b). Semi-intensive
◻ (c). Extensive

B.5 What is your farm milk production? ……. Liters/per day
(a). Morning……. Liters/per day
(b). Evening……. Liters/per day

B.6 What is the average cost of production?

Inputs LKR. …….. + wages LKR. ……. + Other LKR. ……. = Total LKR. …….

B.7 What is the average price you receive for milk? LKR ……. Per Liter

B.8 What is the feeding type you use? (There might be multiple answers to this question please prob and tick)
◻ (a). Own land grazing
◻ (b). Public land grazing
◻ (c). Mineral solutions for cows
◻ (d). Ready-made solutions from the market
◻ (e). Cutting grass
◻ (f). Other ………………..

B.9 What are the average lactating days per year? ……………….. days

B.10 Do you plan to increase milk production during the next 3 years? ◻ Yes ◻ No
If the answer is "YES" go to B.11, otherwise go to B.12

B.11 What is your projected milk production during the next three years?

| Projection | Year | | |
|---|---|---|---|
| | 2024 | 2025 | 2026 |
| Liters Per day | ………… | ………… | ………… |

B.12 Have you undergone any additional training over and above the following: training provided by the milk processor's extension officers when they visit your farm and participate in invited sessions organized by your milk processor? □ Yes □ No

B.13 Do you store milk? □ Yes □ No
If the answer is "YES" go to B.14, otherwise go to B.15

B.14 What is the milk storage method you use?
□ (a). Store in a refrigerator overnight
□ (b). Store elsewhere (please specify) …………………………………

B.15 Do you sell all your milk produced? □ Yes □ No
If the answer is "NO" go to B.16, otherwise go to B.17

B.16 How much do you sell? …………………. Liters/per day

B.17 What is the transport method you use to supply milk to the milk processor? (Please select the most suitable)
□ (a). You deliver milk to the milk processor's collecting/chilling center
□ (b). You deliver milk to the farmer-managed society center
(from which the milk processor collects the milk)
□ (c). You are selling to an intermediary agent
□ (d). Your milk processor's vehicle picks up the milk at the farmgate
□ (e). You are selling milk to a third party (e.g. Dairy Corporative)

B.18 Are you a member of a farmer collective? □ Yes □ No
If the answer is "YES" go to B.19, otherwise go to B.20

B.19 What are the farmer collectives that you hold membership in?
(There might be multiple answers to this question please prob and tick)
□ (a). Farmer Managed Society (in the village)
□ (b). Cooperative society
□ (c). Farmer society of your milk processor
□ (d). Other (specify) ………………………………………

B.20 Do you have any other income sources other than dairy farming? □ Yes □ No
If the answer is "YES" go to B.21, otherwise go to B.22

B.21 What is the contribution of other income sources to your annual household income ……….%

B.22 Why did you select ………………………………….. (Mention the name of the organization that was mentioned in A.2) as your preferred milk processor that you provide more than 75% of your milk?
(There might be multiple answers to this question please prob and tick)
□ (a). Good price for milk
□ (b). Proximity to collecting center
□ (c). Long term relationship
□ (d). Benefits I receive
□ (e). Milk does not get rejected easily
□ (f). Collect milk from the farm gate
□ (g). On-time payment
□ (h). Other (please specify) …………………………………

B.23 Are you planning to switch your milk processor in the next 12 months?
If the answer is "LIKELY/VERY LIKELY" go to B.24, otherwise go to B.25
□ (a). Very unlikely
□ (b). Unlikely
□ (c). Neither likely nor unlikely
□ (d). Likely
□ (e). Very likely

B.24 What is the main reason to move to another milk processor? (Please select the most suitable reason)

□ (a). Better price for milk
□ (b). Closer to the collecting center
□ (c). Reliability on timely payment
□ (d). Better transportation facility
□ (e). High likelihood of milk not getting rejected
□ (f). Other benefits

B.25 Please mark (x) your level of agreement with the following statements on major challenges to your business using Very Low (VL), Low (L), Neither Low nor High (NLNH), High (H) and Very High (VH).

| *You face…* | | VL | L | NLNH | H | VH |
|---|---|---|---|---|---|---|
| B.25.1 | Limited availability of land | □ | □ | □ | □ | □ |
| B.25.2 | Lack of proper financial support | □ | □ | □ | □ | □ |
| B.25.3 | Outbreak of COVID-19 | □ | □ | □ | □ | □ |
| B.25.4 | The high price of animal feed | □ | □ | □ | □ | □ |
| B.25.5 | Limited support from the government | □ | □ | □ | □ | □ |
| B.25.6 | Current economic condition in the country (e.g. very high inflation) | □ | □ | □ | □ | □ |
| B.25.7 | Societal factors *(lack of support from neighbors, lack of appreciation for farming, lack of recognition)* | □ | □ | □ | □ | □ |
| B.25.8 | Limited availability of good cow breeds | □ | □ | □ | □ | □ |
| B.25.9 | Difficult to transport milk to the collection center | □ | □ | □ | □ | □ |
| B.25.10 | Limited availability of grass | □ | □ | □ | □ | □ |
| B.25.11 | Other (specify) ………………………………………………… | □ | □ | □ | □ | □ |

**Closing**

Thank you for your time and information sharing. I would like to ask your kind permission to contact you again to clarify any further information if needed in the future.

# Appendix G: Survey questionnaire (Sinhala translation)

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ප්‍රශ්නාවලියට පිළිතුරු සපයන පුද්ගල අංකය: .......

## ශ්‍රී ලංකාවේ කිරි ගොවීන් සඳහා වන සමීක්ෂණ ප්‍රශ්නාවලිය

මෙම සමීක්ෂණයට සහභාගී වීමට එකඟ වීම ගැන ඔබට බොහෝම ස්තූතියි. ඔබගේ "දැනුවත් කැමැත්ත **(informed consent)**" මා ඔබෙන් ලබාගත්තේ නවසීලන්තයේ මැසේ විශ්ව විද්‍යාලය (Massey University, New Zealand) විසින් අනුගමනය කරන ලද පර්යේෂණ නීති රීති සහ මාර්ගෝපදේශ වලට **(research protocols)** අනුකූලවයි. මගේ නිබන්ධනයේ කිසිදු පුද්ගලික තොරතුරක් මා හෙළි නොකරන බවටත් ඔබ විසින් සපයනු ලබන සියලුම තොරතුරු ඉතා රහසිගතව හසුරුවන බවටත් මම නැවතත් සහතික වෙමි. (කරුණාකර මෙය ගොවියාට කියවන්න)

### අතිරේක පෝරමය

*පර්යේෂණ සහායකයාට උපදෙස්:*

මෙම පෝරමයෙහි පර්යේෂකයාට පිළිතුරු දිය හැකි තෝරාගත් ප්‍රශ්න ඇතුළත් වේ. මෙම පෝරමයෙහි ගොවි මහත්මයා/මහත්මිය සඳහා තෝරා ගැනීමේ ප්‍රශ්න සහ ගොවි මහත්මයා/මහත්මිය පිළිබඳ ජනවිකාස ප්‍රශ්න කිහිපයක් ඇත. මෙම පෝරමයේ ඇති ප්‍රශ්නවලට පිළිතුරු සැපයීමේදී පර්යේෂකයාට ප්‍රශ්න ඇසීමට සහ ඔහුගේම නිරීක්ෂණ, GPS ස්ථාන, සිතියම් සහ ගොවිපලවල වාර්තා භාවිතා කළ හැකිය. පර්යේෂකයා මෙය සමීක්ෂණ ප්‍රශ්නාවලියට ඇමිණිය යුතුය.

**තෝරා ගැනීමේ ප්‍රශ්න**:
(කරුණාකර පහත ප්‍රශ්න ගොවියාට කියවා ගොවියා දෙන නිවැරදි පිළිතුර සලකුණු කරන්න)

1. ඔබ ඔබගේ මුළු කිරි නිෂ්පාදනයෙන් 75%කට වඩා එක් කිරි සකසන ආයතනයකට විකුණන්නේද? □ ඔව් □ නැත
2. ඔබ ගනුදෙනු කරන්නේ එක් ප්‍රධාන කිරි සකසන ආයතනයක් සමඟ පමණක්ද? □ ඔව් □ නැත
3. ඔබගේ ආදායමෙන් 60%කට වඩා වැඩි ප්‍රමාණයක් කිරි ගොවිතැනෙන් උපයනවාද? □ ඔව් □ නැත
4. ඔබගේ ගොවිපළේ ගවයින් පහකට වඩා වැඩි සංඛ්‍යාවක් (≥5ක්) සිටීද නැතහොත් දිනකට කිරි ලීටර් 20 හෝ ඊට (≥20L) නිෂ්පාදනය කරයිද? □ ඔව් □ නැත

*පර්යේෂණ සහායකයාට උපදෙස්:*

*ඉහත ප්‍රශ්නවලින් ඕනෑම එකකට හෝ(1, 2, 3 හෝ 4) ගොවියා "**නැත**" යනුවෙන් පිළිතුරු දුන්නේ නම්, පර්යේෂකයා විසින් ගොවි මහත්මයාට/ මහත්මියට ස්තූති කර ප්‍රශ්නාවලියේ ඉතිරි කොටස පිරවීම නතර කළ යුතුය. ගොවි මහත්මයා/ මහත්මිය සියලු ප්‍රශ්නවලට "ඔව්" යනුවෙන් පිළිතුරු දුන්නේ නම් කරුණාකර ප්‍රශ්නාවලිය දිගටම කරගෙන යන්න*

**ගොවි මහත්මයාගේ තොරතුරු**:
(කරුණාකර පහත ප්‍රශ්න ගොවියාට කියවා ගොවියා දෙන නිවැරදි පිළිතුර සටහන් කරන්න)

5. සමීක්ෂණ දිනය:: ………../………/2023
6. පිළිතුරු දෙන පුද්ගලයාගේ නම (*කාර්යාල ප්‍රයෝජනය සඳහා පමණි*):…………………………………………
7. පිළිතුරු දෙන පුද්ගලයාගේ වයස: අවුරුදු: ……………
8. පිළිතුරු දෙන පුද්ගලයාගේ පාසල් අධ්‍යාපනය: වසර ………… දක්වා අධ්‍යාපනය ලබා ඇත
9. පිළිතුරු දෙන පුද්ගලයාගේ ස්ත්‍රී පුරුෂ භාවය (පර්යේෂණ සහායකයා විසින් සටහන් කළ යුතුය): □ පිරිමි □ ගැහැණු
10. **GPS** ස්ථානය: : …………………………… (නගරය/දිස්ත්‍රික්කය) ..........................................................................

*කාර්යාලීය භාවිතය සඳහා පමණි:*

1. *පර්යේෂකයාගේ හැඳින්වීම (සිංහල සහ දෙමළ පරිවර්තනය අදාළ වන විට) සම්පූර්ණ කරන ලදී: □ ඔව්*
2. *දැනුවත් කැමැත්ත සම්පූර්ණ කරන ලදී: □ ඔව්*
3. *වෙනත් සටහන්:*

## ප්‍රධාන ප්‍රශ්නාවලිය – A කොටස

(කරුණාකර පිළිතුරු ලිවීමට මෙම A කොටස *ගොවි මහත්මයාට/ මහත්මියට දෙන්න. ගොවි මහත්මයා/ මහත්මිය* ප්‍රශ්න කියවන්න කියා ඉල්ලන්නේ නම් පමණක් ප්‍රශ්නය කයවා නිවැරදි පිළිතුර සටහන් කරන්න).

*කරුණාකර ඔබේ කිරි ලබා දෙන ආයතනය/ආයතන පිළිබඳ පහත ප්‍රශ්න සඳහා පිළිතුරු සපයන්න.*

A.1 ඔබ ඔබේ කිරි විකුණන්නේ කුමන ස්ථානයේද/කාටද? (කරුණාකර පිළිතුර ප්‍රතිශතයක් ලෙස සටහන් කරන්න)
……. % ගොවිපල ගේට්ටුව අසල
……. % කිරි එකතු කරන්නාට
……. % කිරි සකසන ආයතනයකට
……. % වෙනත් *(කරුණාකර සඳහන් කරන්න)* …………………………………

A.2 ඔබ ඉහත *ප්‍රශ්න* අංක (A.1) හි සඳහන් කල ඔබේ කිරි ලබා දෙන කිරි සකසන ආයතන පිළිබඳ පහත ප්‍රශ්නවලට පිළිතුරු සපයන්න

| ආයතනය/ආයතන | කිරි විකිණීමට ආරම්භ කල වසර | දෛනිකව සැපයූ කිරි ලීටර් | කිරි ලීටරයක මිල (සාමාන්‍යය.) රු. |
|---|---|---|---|
| 1. ………………………… | …………… | …………… | …………… |
| 2. වෙනත් *(කරුණාකර සඳහන් කරන්න)* ……………… | …………… | …………… | …………… |

*පහත ප්‍රශ්න මඟින් ඔබේ කිරි සැකසුම් ආයතනයෙන් ඔබට ලැබෙන සංවර්ධන සහාය, ඔබේ කිරි සැකසුම් ආයතනය සමඟ ඔබ පවත්වාගෙන යන සබඳතාව සහ ඒවා ඔබේ හැකියාවන් සහ ඔබේ කිරි ගොවිපලෙහි තිරසාර බව වැඩි දියුණු කර ඇති ආකාරය සමීක්ෂණය කරයි. ඔබ ඉහත සඳහන් දැනට ඔබේ කිරි ලබා දෙන ප්‍රධාන කිරි සැකසුම් ආයතනය ගැන සිතා පහත ප්‍රශ්න වලට පිළිතුරු සපයන්න.*

A.3 ඔබේ කිරි සැකසුම් ආයතනයෙන් ලැබෙන සංවර්ධන සහය පිළිබඳ පහත එක් එක් ප්‍රකාශය සඳහා කරුණාකර ලබා දී ඇති පරිමාණය භාවිතා කර ඔබේ එකඟතා මට්ටම හෝ එකඟ නොවීම මට්ටම සලකුණු (x) කරන්න. 1. දැඩි ලෙස එකඟ නොවේ,, 2. එකඟ නොවේ,, 3. එකඟ වේ හෝ නොවේ,, 4. එකඟ වේ,, 5. දැඩි ලෙස එකඟ වේ.

| *ඔබට ඔබේ කිරි සැකසුම් ආයතනය ...* | | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| A.3.17 | කිරි නිෂ්පාදනය වැඩි කිරීම පිළිබඳව හොඳ පුහුණුවක් ලබා දෙයි | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.18 | සත්ව සෞඛ්‍ය හා රෝකවරණය පිළිබඳ හොඳ පුහුණුවක් ලබා දෙයි *(උදා: ගවයින් සඳහා සෙවන සැපයීම, සතුන් සඳහා මුළු දවසම ජලය සැපයීම ආදිය)* | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.19 | කිරිවල ගුණාත්මකභාවය වැඩි දියුණු කිරීම සඳහා හොඳ පුහුණුවක් ලබා දෙයි | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.20 | ගොවිපල ව්‍යාපාර කළමනාකරණය පිළිබඳ හොඳ පුහුණුවක් ලබා දෙයි | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.21 | තිරසාර ගොවිතැන් පිළිවෙත් පිළිබඳ පුහුණුවක් ලබා දෙයි | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.22 | ඔබේ කිරි ව්‍යාපාරය වැඩිදියුණු කිරීම සඳහා ණය ලබා දෙයි | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.23 | කිරි නිෂ්පාදන උපකරණ මිලදී ගැනීමට මූල්‍ය ආධාර සපයයි | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.24 | මූල්‍ය දුෂ්කරතාවලදී ආධාර ලබා දෙයි | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.25 | සත්ව ආහාර අඩු මිලට ලබා දෙයි | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.26 | ණය පදනම මත සත්ව ආහාර සපයයි | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.27 | තෙවන පාර්ශවය හරහා සත්ව සෞඛ්‍ය හා සුභසාධන සේවා සපයයි | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.28 | උසස් තත්ත්වයේ කිරි සඳහා වඩා හොඳ මිලක් ලබා දෙයි | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.29 | කිරි සඳහා නියමිත වේලාවට මුදල් ගෙවයි | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.30 | කිරිවල ගුණාත්මකභාවය වැඩි දියුණු කිරීම සඳහා අවශ්‍ය තොරතුරු ලබා දෙයි | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.31 | ඔබ සමඟ තොරතුරු බෙදා ගැනීමට කාර්යක්ෂම ක්‍රමයක් සපයා ඇත | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.32 | කිරිවල ගුණාත්මක ගැටලුවක් ඇති විට වඩාත්ම සුදුසු විසඳුම කුමක්ද යන්න පිළිබඳ ඔබට ඉතා ඉක්මනින් දැනුම් දෙයි | ☐ | ☐ | ☐ | ☐ | ☐ |

A.4 ඉහත සඳහන් කර ඇති සංවර්ධන සහයන්/ආධාර හැර, වෙනත් සහයන් /ආධාර ඔබට ඔබේ කිරි සැකසුම් ආයතනයෙන් ලබා දෙයි නම් ඒවා කරුණාකර පහත සඳහන් කරන්න.

……………………………………………………………………………………………………………………
……………………………………………………………………………………………………………………

A.5 ඔබ ඔබේ කිරි සැකසුම් ආයතනයේ ගොවි සංවර්ධන වැඩසටහනක සාමාජිකයෙක්ද? ☐ ඔව් ☐ නැත

A.6 පහත එක් එක් ප්‍රකාශය සඳහා, කරුණාකර ඔබ සහ ඔබේ කිරි සැකසුම් ආයතනය අතර ඇති සම්බන්ධය පිළිබඳ ඔබේ අදහස වඩාත් හොඳින් පිළිබිඹු කරන හැකි ප්‍රතිචාර විකල්ප පහෙන් එකක් **(X)** තෝරන්න. 1. දැඩි ලෙස එකඟ නොවේ,, 2. එකඟ නොවේ,, 3. එකඟ වේ හෝ නොවේ,, 4. එකඟ වේ,, 5. දැඩි ලෙස එකඟ වේ.

| **ඔබ** ... | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|
| A.6.11 ඔබේ කිරි සැකසුම් ආයතනයෙන් ලැබෙන මිල ගැන සෑහීමකට පත්වේ | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.6.12 ඔබේ කිරි සැකසුම් ආයතනයට කිරි සැපයීමෙන් ලැබෙන ශුද්ධ ප්‍රතිලාභය ගැන සෑහීමකට පත්වේ | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.6.13 ඔබේ කිරි සැකසුම් ආයතනය සමඟ සන්නිවේදනයෙ යෙදෙන වාර ගණන ගැන සෑහීමකට පත්වේ | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.6.14 ඔබේ කිරි සැකසුම් ආයතනය ඔබට අවංක තොරතුරු සපයන බව විශ්වාස කරයි. (උදා: ඔබගේ කිරිවල ගුණාත්මකභාවය සහ ගෙවීම් පිළිබඳ නිවැරදි වාර්තා පවත්වාගෙන යාම) | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.6.15 ඔබේ කිරි සැකසුම් ආයතනය ඔබට අවශ්‍ය සහය ලබා දීමට කැමති බව විශ්වාස කරයි | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.6.16 ඔබේ කිරි සැකසුම් ආයතනය ඔබ සමඟ සබඳතා පවත්වාගෙන යාමේදී අනුගමනය කරන ආචාර ධර්ම ගැන සෑහීමකට පත්වේ | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.6.17 ඔබේ කිරි සැකසුම් ආයතනය ව්‍යාපාර ක්ෂේත්‍රයේ ප්‍රවීණ යෙක් බව විශ්වාස කරයි | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.6.18 ඉදිරි වසර 2 තුළ ඔබේ කිරි සැකසුම් ආයතනය වෙත ඔබේ කිරි සියල්ල ලබාදීමට කැපවී සිටියයුතු බව හැඟේ | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.6.19 ඔබගේ වර්තමාන කිරි සැකසුම් ආයතනයෙ අවශ්‍යතා වඩා හොඳින් සපුරාලීම සඳහා ඔබේ ගොවිපලෙහි අවශ්‍ය වෙනස්කම් කිරීමට කැමැත්තෙන් සිටීයි | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.6.20 ඔබ මෙම කිරි සැකසුම් ආයතනයට සැපයුම්කරුවෙකු බව අනෙකුත් ගොවීන්ට පැවසීමට ආඩම්බරයි | ☐ | ☐ | ☐ | ☐ | ☐ |

A.7 පහත එක් එක් ප්‍රකාශය සඳහා, කරුණාකර ඔබේ සසමාජීය, පාරිසරික සහ ආර්ථික ක්‍රියාකාරිත්වය පිළිබඳ ඔබේ අදහස වඩාත් හොඳින් පිළිබිඹු කර හැකි ප්‍රතිචාර විකල්ප පහෙන් එකක් **(X)** තෝරන්න. 1. දැඩි ලෙස එකඟ නොවේ,, 2. එකඟ නොවේ,, 3. එකඟ වේ හෝ නොවේ,, 4. එකඟ වේ,, 5. දැඩි ලෙස එකඟ වේ.

| **ඔබ** ... | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|
| A.7.10 ඔබේ කිරි ගොවිපළේ දළ ආදායම ගැන සෑහීමකට පත්විය හැක | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.7.11 කිරි ගොවිතැනෙන් ලැබෙන ආදායම ඔබගේ නිවසේ සියලුම මූල්‍ය අවශ්‍යතා සපුරාලීමට ප්‍රමාණවත් බව සෑහීමකට පත් වේ | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.7.12 කිරි නිෂ්පාදන ව්‍යාපාරයේ ආදායම ගැන සෑහීමකට පත්විය හැක | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.7.13 කිරි නිෂ්පාදනයෙන් ලැබෙන ජීවන තත්ත්වය ගැන සෑහීමකට පත් වේ | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.7.14 ඔබේ දරුවන්ට හොඳ අධ්‍යාපනයක් ලබා දීමට ඔබට හැකි වීම ගැන සෑහීමකට පත්වේ | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.7.15 අන්‍යෝන්‍ය කෘෂිකාර්මික ක්‍රියාකාරකම් හේතුවෙන් ඔබට ප්‍රජාවෙන් ලැබෙන පිළිගැනීම ගැන සෑහීමකට පත්වේ | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.7.16 අපද්‍රව්‍ය බැහැර කිරීමට විධිමත් ක්‍රමවේදයක් නොමැත (R) | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.7.17 කෘෂිකාර්මික කටයුතු සඳහා ඝන අපද්‍රව්‍ය *(උදා: පොහොර) භාවිතා කරයි (අනෙකුත් ගොවීන්ට විකිණීම හෝ නොමිලේ ලබා දීම ද පිළිගත හැකිය)* | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.7.18 කිරි ගොවිතැනෙන් හානිකර වායු විමෝචනය සහ වායු දූෂණය අවම කිරීමට කිසිදු ක්‍රියාමාර්ගයක් නොගනීයි *(පහත සඳහන් කරුණු සලකා බලා සමස්ත ප්‍රතිචාරයක් දක්වන්න: ගව මඩුව නිතිපතා පිරිසිදු කිරීම, පොහොර කොම්පෝස්ට් කිරීම සහ ආවරණය කරන ලද ගබඩා පහසුකම් භාවිතා කිරීම, ගවයින්ගේ පෝෂණ අවශ්‍යතාවලට සරිලන පරිදි ආහාර සලාක සකස් කිරීම, පහසුවෙන් දිරවිය හැකි දේශීය ආහාර බෝග භාවිතා කිරීම)* | ☐ | ☐ | ☐ | ☐ | ☐ |

A.8 පහත එක් එක් ප්‍රකාශය සඳහා, කරුණාකර පහත සඳහන් අංගයන් මත ඔබේ හැකියාව **(X)** අගයන්න. 1. ඉතා අඩුයි, 2. අඩුයි, 3 අඩුයි හෝ ඉහළ නොවේ, 4. ඉහළයි, 5. ඉතා ඉහළයි

| **ඔබ** ... | | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|---|
| A.8.5 | පුහුණු වැඩසටහන් වලින් ඔබ ලබා ගන්නා දැනුම භාවිත කරයි | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.8.6 | ක්ෂේත්‍ර නිලධාරීන් සමඟ සමීප සබඳතා පවත්වයි | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.8.7 | එකඟ වූ ප්‍රමාණයට වසර පුරා කිරි සැපයුම ලබා දීමට පියවර සඳහා පියවර ගනු *ලබයි* | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.8.8 | කිරි ගුණාත්මක පිරිවිතරයන් සපුරාලිය හැකිය | ☐ | ☐ | ☐ | ☐ | ☐ |

## ප්‍රධාන ප්‍රශ්නාවලිය – B කොටස

(කරුණාකර ගොවියාට පහත ප්‍රශ්න කියවා ගොවියා ලබා දුන් නිවැරදි පිළිතුර ලියන්න)

*කරුණාකර ඔබේ කිරි ගොවිපල, කිරි නිෂ්පාදනය, කිරි සැකසුම්කරු, කිරි ගොවිපල භාවිතයන් සහ අභියෝග පිළිබඳ පහත ප්‍රශ්න සඳහා පිළිතුරු සපයන්න.*

B.1 කිරි ගොවිතැන පිළිබඳ ඔබගේ පළපුරුද්ද කොපමණ ද? අවුරුදු…………

B.2 ඔබගේ ගොවිපල ප්‍රමාණය කොපමණ ද? පර්චස් ……………………

B.3 ඔබට ගවයින් කී දෙනෙක් සිටීද? ගවයින් ………… (දේශීය ගවයින් …….. + ආනයන කළ ගවයින් ……. + හරස් අභිජනන ගවයින් ………)

B.4 ඔබේ ගොවිපල කළමනාකරණ පද්ධතිය කුමක්ද?
☐ (a). දැඩි Intensive
☐ (b). අර්ධ-දැඩි Semi-intensive
☐ (c). පුළුල් Extensive

B.5 ඔබගේ ගොවිපලේ දෛනික කිරි නිෂ්පාදනය කොපමණ ද? ……
(a). උදෑසන ……. දිනකට ලීටර
(b). සවස ……. දිනකට ලීටර

B.6 ඔබගේ ගොවිපලේ දෛනික කිරි නිෂ්පාදනයේ සාමාන්‍ය පිරිවැය කොපමණද?

යෙදවුම් රු. …….. + වැටුප් රු. ……. + වෙනත් රු. ……. = මුළු රු.…….

B.7 කිරි සඳහා ඔබට ලැබෙන සාමාන්‍ය මිල කොපමණද? ලීටරයකට රු.

B.8 ඔබ ගවයින්ට ලබා දෙන ආහාර වර්ග/ වර්ගය කුමක්ද? *(මෙම ප්‍රශ්නයට පිළිතුරු කිහිපයක් තිබිය හැක අසා සඳහන් කරන්න)*
☐ (a). ඔබගේම තණබිම්/ ඉඩම්වල තණකොළ
☐ (b). පොදු තණබිම්/ ඉඩම්වල
☐ (c). ගවයින් සඳහා සකස් කළ ඛනිජ වර්ග
☐ (d). වෙළඳපොලෙන් මිලදී ගත හැකි සකස් කළ ආහාර
☐ (e). කපන ලද තණකොළ
☐ (f). වෙනත් ………………..

B.9 වසරකට ඔබ කිරි දොවන සාමාන්‍ය දින ගණන කොපමණ ද? දින ………………..

B.10 ඉදිරි වසර තුන (03) තුළ කිරි නිෂ්පාදනය වැඩි කිරීමට ඔබ අදහස් කරනවාද? ☐ ඔව් ☐ නැත
පිළිතුර "ඔව්" නම් B.11 වෙත යන්න, නැතිනම් B.12 වෙත යන්න

B.11 ඉදිරි වසර තුනට ප්‍රක්ෂේපණය කළ කිරි නිෂ්පාදනය කොපමණද?

| ප්‍රක්ෂේපණය | වසර | | |
|---|---|---|---|
| | 2024 | 2025 | 2026 |
| දිනකට ලීටර | ……….. | ……….. | ……….. |

B.12 ඔබ පහත සඳහන් කරුණුවලට වඩා වැඩි අමතර පුහුණුවක් ලබා තිබේද? (කිරි සැකසුම් ආයතනයේ ක්ෂේත්‍ර නිලධාරීන් ඔබේ ගොවිපළට පැමිණෙන විට හෝ ඔබේ කිරි සැකසුම්කරු විසින් සංවිධානය කරන ලද ආරාධිත සැසිවලට සහභාගි වන විට ඔවුන් විසින් සපයනු ලබන පුහුණුව හැරුණු විට).
☐ ඔව් ☐ නැත

B.13 ඔබ කිරි ගබඩා කරනවාද? ☐ ඔව් ☐ නැත පිළිතුර "ඔව්" නම් B.14 වෙත යන්න, නැතිනම් B.15 වෙත යන්න

B.14 ඔබ භාවිතා කරන කිරි ගබඩා කිරීමේ ක්‍රමය කුමක්ද?
☐ (a). එක රැයක් ශීතකරණයක් තුළ ගබඩා කිරීම
☐ (b). වෙනත් ස්ථානයක ගබඩා කිරීම (කරුණාකර සඳහන් කරන්න) …………………………………

B.15 ඔබ නිෂ්පාදනය කරන කිරි සියල්ල විකුණනවාද? ☐ ඔව් ☐ නැත
පිළිතුර " නැත" නම් B.16 වෙත යන්න, නැතිනම් B.17 වෙත යන්න

B.16 ඔබ නිෂ්පාදිත කිරි වලින් කොපමණ කිරි විකුණනවාද? දිනකට ලීටර …………………

B.17 කිරි සකසන ආයතනයට කිරි සැපයීම සඳහා ඔබ භාවිතා කරන ප්‍රවාහන ක්‍රමය කුමක්ද?
*(කරුණාකර වඩාත් සුදුසු පිළිතුර තෝරන්න)*

- ☐ (a). ඔබ කිරි සැකසුම් ආයතන එකතු කිරීමේ/සිසිල් කිරීමේ මධ්‍යස්ථානයට කිරි ලබා දෙයි
- ☐ (b).ඔබ ගොවි කළමනාකරණ සමිති (FMS) මධ්‍යස්ථානයට කිරි ලබා දෙයි (කිරි සැකසුම්කරු කිරි එතනින් එකතු කරයි)
- ☐ (c). ඔබ අතරමැදි කිරි එකතු කරන නියෝජිතයෙකුට විකුණනු ලබයි
- ☐ (d). ඔබේ කිරි සැකසුම් ආයතන වාහනය ගොවිපල දොරටුවෙන් කිරි ලබා ගනියි
- ☐ (e). ඔබ තුන්වන පාර්ශ්වයකට කිරි විකුණනු ලබයි (උදා. කිරි සංස්ථාපිත)

B.18 ඔබ ගොවි සාමූහිකයක සාමාජිකයෙක්ද? ☐ ඔව් ☐ නැත
පිළිතුර "ඔව්" නම් B.19 වෙත යන්න, නැතිනම් B.20 වෙත යන්න

B.19 ඔබ සාමාජිකත්වය දරන ගොවි සාමූහික මොනවාද?
(මෙම ප්‍රශ්නයට පිළිතුරු කිහිපයක් තිබිය හැක අසා සඳහන් කරන්න)

- ☐ (a). ගොවි කළමනාකරණය කරන ලද සමිතිය (Farmer Managed Society of the village)
- ☐ (b). සමුපකාර සමිතිය
- ☐ (c). කිරි සකසන ආයතනයේ ගොවි සමාජය
- ☐ (d). වෙනත් (කරුණාකර සඳහන් කරන්න) ………………………………………

B.20 ඔබට කිරි ගොවිතැන හැර වෙනත් ආදායම් මාර්ග තිබේද? ☐ ඔව් ☐ නැත
පිළිතුර "ඔව්" නම් B.21 වෙත යන්න, නැතිනම් B.22 වෙත යන්න

B.21 ඔබේ වාර්ෂික කුටුම්භ ආදායමට අනෙකුත් ආදායම් ප්‍රභවයන්ගේ දායකත්වය ප්‍රතිශතයක් ලෙස කොපමණ ද? ……….%

B.22 ඔබ ඉහත ප්‍රශ්න අංක (A.2) සඳහන් කළ ආයතන අතරින් ඔබේ කිරිවලින් අවම වශයෙන් 75% ලබා දෙන ආයතනය.......... (ආයතනයේ නම සඳහන් කරන්න) ඔබේ කිරි විකිණීමට වඩාත්ම සුදුසු ආයතනය ලෙස ඔබ තෝරා ගන්නේ ඇයි?
*(මෙම ප්‍රශ්නයට පිළිතුරු කිහිපයක් තිබිය හැක අසා සඳහන් කරන්න).*

- ☐ (a). ඔබට කිරි සඳහා හොඳ මිලක් ගෙවීම
- ☐ (b). කිරි එකතු කිරීමේ මධ්‍යස්ථානය ඔබට සමීපව පිහිටා තිබීම
- ☐ (c). ඔබට ආයතනය සමග දිගුකාලීන සබඳතාවයක් තිබීම
- ☐ (d). ඔබට ආයතනයෙන් ලැබෙන ප්‍රතිලාභ
- ☐ (e). ආයතනය ලේසියෙන් කිරි ප්‍රතික්ෂේප නොකිරීම
- ☐ (f). ආයතනය ගොවිපළ ගේට්ටුවළඟින්ම කිරි එකතු කිරීම
- ☐ (g). කිරි සඳහා නියමිත වේලාවට මුදල්ගෙවීම
- ☐ (h). වෙනත් *(කරුණාකර සඳහන් කරන්න)* .........................................................

B.23 ඉදිරි මාස 12 තුළ, ඔබ ඔබේ ප්‍රධාන කිරි ලබා දෙන ආයතනය මාරු කිරීමට සැලසුම් කරනවාද?
*පිළිතුර "විය හැකිය / බෙහෙවින් විය හැකිය" නම් B.24 වෙත යන්න, නැතිනම් B.25 වෙත යන්න*

- ☐ (a). බෙහෙවින් විය නොහැකිය
- ☐ (b). විය නොහැකිය
- ☐ (c). විය හැකි හෝ විය නොහැක
- ☐ (d). විය හැකිය
- ☐ (e). බෙහෙවින් විය හැකිය

B.24 ඔබ වෙනත් කිරි සකසන ආයතනයට මාරු වීමට ප්‍රධාන හේතුව කුමක්ද?
(කරුණාකර වඩාත් සුදුසු හේතුව සටහන් කරන්න)

- ☐ (a). සපයන කිරි සඳහා වඩා හොඳ මිලක් ලැබීම
- ☐ (b). එම ආයතනයෙ කිරි එකතු කිරීමේ මධ්‍යස්ථානය ඔබට සමීපව පිහිටා තිබීම
- ☐ (c). සපයන කිරි සඳහා නියමිත වේලාවට ගෙවනු ඇතැයි යන විශ්වාසය
- ☐ (d). එම ආයතනය වඩා හොඳ ප්‍රවාහන පහසුකම් සැපයීම
- ☐ (e). එම ආයතනය කිරි ප්‍රතික්ෂේප නොකිරීමේ ඉහළ සම්භාවිතාව
- ☐ (f). වෙනත් ප්‍රතිලාභ

B.25 කරුණාකර ඔබේ ව්‍යාපාරයට ඇති ප්‍රධාන අභියෝග පිළිබඳ පහත ප්‍රකාශ සමඟ ඔබේ එකඟතා මට්ටම ප්‍රකාශ කරන්න. කරුණාකර පහත සඳහන් අංගයන් මත ඔබේ හැකියාව **(X)** අගයන්න. 1. ඉතා අඩුයි, 2.අඩුයි, 3 අඩුයි හෝ ඉහළ නොවේ, 4. ඉහළයි, 5. ඉතා ඉහළයි

| ***ඔබ මුහුණ දෙන අභියෝගය...*** | | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|---|
| B.25.1 | සීමිත ඉඩ ප්‍රමාණයක්තිබීම | ☐ | ☐ | ☐ | ☐ | ☐ |
| B.25.2 | නිසි මූල්‍ය ආධාර නොමැතිකම | ☐ | ☐ | ☐ | ☐ | ☐ |
| B.25.3 | කොවිඩ් වසංගතය පැතිරීම | ☐ | ☐ | ☐ | ☐ | ☐ |
| B.25.4 | සත්ව ආහාරවල ඉහළ මිල | ☐ | ☐ | ☐ | ☐ | ☐ |
| B.25.5 | රජයෙන් ලැබෙන සහයෝගය සීමිතයි/ ප්‍රමාණවත් නොමැතිකම | ☐ | ☐ | ☐ | ☐ | ☐ |
| B.25.6 | රටේ වත්මන් ආර්ථික වාතාවරණය *(උදා. ඉතා ඉහළ උද්ධමනය)* | ☐ | ☐ | ☐ | ☐ | ☐ |
| B.25.7 | සමාජීය සාධක *(අසල්වාසීන්ගේ සහයෝගය නොමැතිකම, ගොවිතැන අගය නොකිරීම, පිළිගැනීමක් නොමැතිකම)* | ☐ | ☐ | ☐ | ☐ | ☐ |
| B.25.8 | හොඳ ගව වර්ග සීමිතයි/ ප්‍රමාණවත් නොමැතිකම | ☐ | ☐ | ☐ | ☐ | ☐ |
| B.25.9 | කිරි එකතු කිරීමේ මධ්‍යස්ථානයට ප්‍රවාහනය කිරීමට අපහසුකම | ☐ | ☐ | ☐ | ☐ | ☐ |
| B.25.10 | තණකොළ සීමිතයි/ ප්‍රමාණවත් නොමැතිකම | ☐ | ☐ | ☐ | ☐ | ☐ |
| B.25.11 | වෙනත් (කරුණාකර සඳහන් කරන්න) ...................................... | ☐ | ☐ | ☐ | ☐ | ☐ |

## ප්‍රශ්නාවලියේ අවසානය

ඔබගේ කාලය සහ තොරතුරු බෙදාගැනීම සඳහා ස්තූතියි. අනාගතයේදී අවශ්‍ය නම් වැඩිදුර තොරතුරු පැහැදිලි කර ගැනීමට නැවත ඔබ හා සම්බන්ධ වීමට ඔබගේ කාරුණික අවසරය ඉල්ලා සිටීමට කැමැත්තෙමි.

## Appendix H: Survey questionnaire (Tamil translation)

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ஆய்வு இல.........

**இலங்கையில் பால் பண்ணையாளர்களுக்கான ஆய்வுக் கேள்வித்தாள்**

இந்த நேர்காணலில் பங்கேற்க ஒப்புக்கொண்டமைக்கு மிக்க நன்றி. நியூசிலாந்தின் மஸி பல்கலைக்கழகத்தினால் பின்பற்றப்படுகின்ற ஆராய்ச்சி நெறிமுறைகளின் நிபந்தனைகளுக்கு அமைவாக நான் உங்களிடமிருந்து "தகவல் அறிந்த ஒப்புதலைப்" பெற்றுக் கொள்கின்றேன். இது நான் உங்களிடமிருந்து பெற்றுக்கொண்ட எந்தவொரு தனிப்பட்ட தகவலையும் எனது அறிக்கையில் வெளிப்படுத்தமாட்டேன் என்பதையும் உங்களால் வழங்கப்பட்ட அனைத்து தகவல்களும் மிகுந்த இரகசியத்துடன் பின்பற்றப்படும் என்பதையும் மீள உறுதிப்படுத்துகின்றது. (தயவுசெய்து இதனை பண்ணையாளருக்கு வாசித்துக் காண்பிக்கவும்)

**துணைப் படிவம்**

ஆய்வாளருக்கான குறிப்பு:

இந்த படிவத்தில் ஆய்வாளரால் பதிலளிக்ககூடிய தெரிவுசெய்யப்பட்ட வினாக்கள் உள்ளடக்கப்பட்டுள்ளது. இந்தப் படிவத்தில் பண்ணையாளர்கள் தொடர்பான பரீட்சார்த்த வினாக்கள் மற்றும் பண்ணையாளர்கள் தொடர்பான சில மக்கள்தொகையியல் கேள்விகளும் உள்ளடக்கப்பட்டுள்ளன. ஆய்வாளர் கேள்விகளைக் கேட்கலாம் மற்றும் இவ் வினாக்களுக்கான பதில்களை ஆய்வாளர் இப்படிவத்தில் உள்ள வினாக்களைக் கேட்பதனூடாகவோ, தனது தனிப்பட்ட அவதானிப்பு, GPS இருப்பிடம், வரைபடங்கள் மற்றும் பண்ணையிலுள்ள பதிவுகளின் உதவியினுடனோ பூரணப்படுத்த முடியும். ஆய்வாளர் இதை ஆய்வுக் கேள்வித்தாளில் இணைக்க வேண்டும்.

**பரீட்சார்த்த வினாக்கள் :**

தயவுசெய்து பண்ணையாளருக்கு பின்வரும் கேள்விகளை வாசித்து, பண்ணையாளர் அளித்த சரியான பதிலைக் குறிக்கவும்

1. பண்ணையாளர் ஒரு பால் பதனிடும் நிறுவனத்திற்கு 75% க்கும் அதிகமான பாலை விற்பனை செய்கிறாரா?
   ☐ ஆம் ☐ இல்லை
2. பண்ணையாளர் ஒரே ஒரு பிரதான/முக்கிய பால் பதனிடும் நிறுவனத்தினுடன் உடன்படிக்கையிலுள்ளாரா? ☐ ஆம் ☐ இல்லை
3. பண்ணையாளர் பால் பண்ணையுற்பத்தியினூடாக 60% க்கும் அதிகமான வருமானம் பெறுகின்றாரா?
   ☐ ஆம் ☐ இல்லை
4. பண்ணையாளரிடம் $\geq 5$ பசு மாடுகள் உள்ளனவா அல்லது ஒரு நாளைக்கு $\geq 20$L பால் உற்பத்தி செய்கின்றாரா? ☐ ஆம் ☐ இல்லை

ஆய்வாளருக்கான குறிப்பு:

மேலே உள்ள ஏதேனும் கேள்விகளுக்கு (Q1, Q2, Q3 அல்லது Q4 ) பண்ணையாளர் "இல்லை" என்று பதிலளித்தால், ஆய்வாளர் பண்ணையாளருக்கு நன்றி தெரிவிப்பதுடன் மீதமுள்ள கேள்விகளை நிரப்புவதை நிறுத்த வேண்டும்.

**பண்ணையாளருடைய தகவல்:**

தயவுசெய்து பண்ணையாளருக்கு பின்வரும் கேள்விகளை வாசித்து, பண்ணையாளர் அளித்த சரியான பதிலை எழுதவும்

5. ஆய்வுத் திகதி: .........../........./2023
6. பதிலளித்தவரின் பெயர் (அலுவலக உபயோகத்துக்கு மட்டும்): ..........................................................................
7. பதிலளித்தவரின் வயது: ............... வருடங்கள்
8. பதிலளித்தவரின் பாடசாலைக் கல்வி..................... வருடங்கள்
9. பதிலளித்தவரின் பாலினம் (ஆராய்ச்சியாளரால் கவனிக்கப்பட வேண்டும்): ☐ ஆண் ☐ பெண்
10. பண்ணையின் GPS அமைவிடம்: .................................. (நகரம்/மாவட்டம்)

*அலுவலகப் பாவனைக்கு மட்டும்*
ஆய்வாளரின் அறிமுகம் (தேவைப்படும் இடங்களில் சிங்களம் மற்றும் தமிழ் மொழிபெயர்ப்பாளர்) நிறைவேற்றப்பட்டது:
☐ ஆம்

1. *தகவல் அறிந்த ஒப்புதல் பெற்றுக் கொள்ளப்பட்டது:* ☐ ஆம்
2. *ஏனைய களக் குறிப்புக்கள்:*

## பிரதான கேள்வித்தாள்- பகுதி A

(கேள்வித்தாளின் இந்தப் பகுதி A-யினை பால் பண்ணையாளரிடம் கொடுத்து பூரணப்படுத்தவும். பண்ணையாளர் உங்களிடம் கேள்வியினை வாசிக்கும்படி கோரினால் மட்டும், தயவுசெய்து அதனைப் படித்து பொருத்தமான பதிலைக் குறிக்கவும்).

**தயவுசெய்து நீங்கள் பால் விநியோகம் செய்யும் நிறுவனங்களைப் பற்றிய பின்வரும் கேள்விகளுக்கு பதிலளிக்கவும்.**

A.1 உங்களுடைய பாலை எங்கே/யாருக்கு விநியோகிக்கிறீர்கள்? (தயவுசெய்து பதிலை சதவீதத்தில் குறிப்பிடவும்)

....... % பண்ணை வாசலில்
....... % ஒரு பால் சேகரிப்பாளருக்கு
....... % ஒரு பால் பதனிடும் நிறுவனத்திற்க்கு
....... % வேறு ஏதேனும் (தயவுசெய்து குறிப்பிடவும்) ..........................................

A.2 மேலே A.1 இல் குறிப்பிட்டுள்ளபடி நீங்கள் பால் விற்பனை செய்யும் நிறுவனங்கள் அல்லது உங்களுடைய பால் பதனிடும் நிறுவனம் பற்றிய பின்வரும் கேள்விகளுக்கு பதில் அளிக்கவும்.

| கம்பனி | தொடக்க ஆண்டு | விநியோகிக்கப்பட்ட அளவு (லீட்டர்/நாள்) | சராசரி ஒரு லீட்டர் பாலின் விலை |
|---|---|---|---|
| 1. கார்கில்ஸ் | .................... | ............................ | ரு......................... |
| 4.வேறு ...................... | .................... | ............................ | ரு............................ |

**கேள்வித்தாளின் இந்தப் பகுதியானது, உங்களுடைய பிரதான பால் பதனிடும் நிறுவனத்திடம் இருந்து நீங்கள் பெறும் அபிவிருத்தி உதவிகள், மற்றும் உங்களுடைய பால் உற்பத்தி நிறுவனத்துடன் உங்களுடைய உறவு மற்றும் அவை உங்கள் உற்பத்தி திறன் மற்றும் உங்களுடைய செயல்திறனையும் எவ்வாறு மேம்படுத்தியுள்ளன என்பதை ஆய்வு செய்கிறது. நீங்கள் தற்போது வேலைசெய்யும் முக்கிய பால் பதனிடும் நிறுவனத்தினைப் பற்றி சிந்தித்து பின்வரும் கேள்விகளுக்கு பதிலளிக்கவும்.**

A.3 உங்களுடைய பால் பதனிடும் நிறுவனத்திடம் இருந்து பெறப்பட்ட உதவிகள், ஆதரவுகள் தொடர்பான ஒவ்வொரு அறிக்கைக்கும் உங்களுடைய உடன்பாட்டின் அல்லது கருத்து வேறுபாட்டின் அளவை (x) தெரிவுசெய்யவும். **1. உறுதியாக உடன்படவில்லை, 2. உடன்படவில்லை, 3. உடன்பாடு மற்றும் வேறுபாடு இரண்டுமில்லை, 4. உடன்படுகிறேன், 5. உறுதியாக உடன்படுகிறேன்.**

| | நீங்கள் நினைக்கின்றீர்களா உங்களுடைய பால் பதனிடும் நிறுவனம் .... | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| A.3.1 | பால் உற்பத்தியை எவ்வாறு அதிகரிப்பது குறித்து போதுமான பயிற்சியளிக்கிறது | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.2 | விலங்குகளின் ஆரோக்கியம் மற்றும் பராமரிப்பு தொடர்பாக சிறந்த பயிற்சியளிக்கிறது | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.3 | பாலின் தரத்தை மேம்படுத்துவது தொடர்பாக சிறந்த பயிற்சியளிக்கிறது | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.4 | பண்ணை வணிக முகாமைத்துவம் குறித்து சிறந்த பயிற்சியளிக்கிறது | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.5 | நிலைபேண்தகு விவசாய முறைகள் குறித்து சிறந்த பயிற்சியளிக்கிறது | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.6 | என்னுடைய பால் வியாபாரத்தை மேம்படுத்த வட்டியில்லா கடன்களை வழங்குகின்றது | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.7 | பால் உபகரணங்கள் வாங்குவதற்கு நிதி உதவி வழங்குகின்றது | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.8 | நெருக்கடியின் போது நிதி ஆதரவை வழங்குகின்றது | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.9 | கால்நடைத் தீவனத்தை குறைந்த விலையில் வழங்குகின்றது | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.10 | கடன் அடிப்படையில் கால்நடைத் தீவனத்தை வழங்குகின்றது | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.11 | மூன்றாம் நபர் விலங்குகளின் ஆரோக்கியம் மற்றும் நலன்புரி தொடர்பான சேவைகளை ஏற்பாடு செய்கிறது. | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.12 | உயர்தரமான பாலுக்கு சிறந்த விலை சலுகையளிக்கிறது | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.13 | சரியான நேரத்தில் பணம் செலுத்துகின்றது | ☐ | ☐ | ☐ | ☐ | ☐ |
| A.3.14 | பால் தரத்தை மேம்படுத்தும் வழிகள் தொடர்பான தகவலை பகிர்கின்றுத | ☐ | ☐ | ☐ | ☐ | ☐ |

| | | | | | | |
|---|---|---|---|---|---|---|
| A.3.15 | வெளிப்படைத்தன்மைக்காக எனது பாலின் தரம் தொடர்பான தகவலை பகிர்ந்துகொள்ள வினைத்திறனான தளத்தினைக் கொண்டுள்ளது | □ | □ | □ | □ | □ |
| A.3.16 | பால் தரத்தில் சிக்கல் இருக்கும்போது சரியான நேரத்தில் பின்னூட்டல்களை வழங்குகிறது | □ | □ | □ | □ | □ |

A.4 மேலே குறிப்பிட்டவற்றிற்கு மேலதிகமாக உங்களுக்கு பால் பதனிடும் நிறுவனத்திடமிருந்து வேறு ஏதேனும் அபிவிருத்தி செயற்பாடுகள் கிடைக்கப்பெற்றிருந்தால் தயவுசெய்து குறிப்பிடவும்.

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A.5 உமது பால் பதனிடும் நிறுவனத்தின் ஏதேனும் மேம்பாட்டுத் திட்டத்தில் நீர் உறுப்பினரக உள்ளீரா? □ ஆம் □ இல்லை

A.6 கீழே உள்ள ஒவ்வொரு கூற்றுக்கும், உங்களுக்கும் உங்கள் பால் பதனிடும் நிறுவனத்திற்கும் இடையிலான உறவைப் பற்றிய உங்கள் பார்வையை சிறப்பாக பிரதிபலிக்கும் ஐந்து சாத்தியமான பதில் விருப்பங்களில் ஒன்றை 1 உறுதியாக உடன்படவில்லை, 2 உடன்படவில்லை, 3 உடன்பாடு மற்றும் வேறுபாடு இரண்டுமில்லை, 4 உடன்படுகிறேன், 5 உறுதியாக உடன்படுகிறேன் ஆகியவற்றைப் பயன்படுத்தி (x) எனக் குறிக்கவும்.

| | நீங்கள் … | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| A.6.1 | உங்களுடைய பால் பதனிடும் நிறுவனம் செலுத்தும் விலையுடன் திருப்தி அடைகின்றீர்கள் | □ | □ | □ | □ | □ |
| A.6.2 | உங்களுடைய பால் பதனிடும் நிறுவனத்திற்கு பால் வழங்குவதன் மூலம் பெறப்படும் தேறிய வருமானத்தில் திருப்தி அடைகின்றீர்கள் | □ | □ | □ | □ | □ |
| A.6.3 | உங்களுடைய பால் பதனிடும் நிறுவனத்துடனான இருவழி தொடர்புகொள்ளும் தடவைகளில் திருப்தி அடைகின்றீர்கள் | □ | □ | □ | □ | □ |
| A.6.4 | உங்களுடைய பால் பதனிடும் நிறுவனம் உங்களது வணிகத்திற்கு முக்கியமான நேர்மையான தகவலை வழங்குகிறது என்று நம்புகின்றீர்கள் (பாலின் தரம் மற்றம் கொள்வனவு தொடர்பில் சரியான பதிவுகளைப் பேணுகிறது) | □ | □ | □ | □ | □ |
| A.6.5 | தேவையான நேரத்தில் உதவிகளுக்காக உங்களது பால் பதனிடும் நிறுவனம் மீது தங்கியிருக்க முடியும் என்று நம்புகிறீர்கள் | □ | □ | □ | □ | □ |
| A.6.6 | உங்களுடைய பால் பதனிடும் நிறுவனம் உங்கள் வணிக உறவில் கொண்டுள்ள பெறுமதிகளை விரும்புகின்றீர்கள் | □ | □ | □ | □ | □ |
| A.6.7 | உங்களுடைய பால் பதனிடும் நிறுவனம் உங்களுடன் வணிகம் செய்வதில் நிபுணத்துவம் வாய்ந்தவரகள் என நம்புகிறீர்கள் | □ | □ | □ | □ | □ |
| A.6.8 | அடுத்த இரண்டு ஆண்டுகளிற்கு உங்கள் பால் பதனிடும் நிறுவனத்திற்கு உங்கள் பால் முழுவதையும் வழங்க உறுதியாக இருப்பதாக உணர்கின்றீர்கள் | □ | □ | □ | □ | □ |
| A.6.9 | உங்களுடைய தற்போதைய பால் பதனிடும் நிறுவனத்தின் தேவைப்பாடுகளைச் சிறப்பாக பூர்த்தி செய்ய உங்கள் பண்ணையில் மாற்றங்களைச் செய்ய விரும்புகிறீர்கள் | □ | □ | □ | □ | □ |
| A.6.10 | இந்த பால் பதனிடும் நிறுவனத்திற்கு நீஙகள் ஒரு விநியோகஸ்தராக இருப்பதில் பெருமை கொள்கின்றீர்கள் | □ | □ | □ | □ | □ |

A.7 கீழே உள்ள ஒவ்வொரு கூற்றுக்கும், உங்கள் சமூக, சுற்றுச்சூழல் மற்றும் பொருளாதார செயல்திறன் குறித்த உங்கள் பார்வையை சிறப்பாக பிரதிபலிக்கும் ஐந்து சாத்தியமான பதில் விருப்பங்களில் ஒன்றை (x) என , 1 உறுதியாக உடன்படவில்லை, 2 உடன்படவில்லை, 3 உடன்பாடு மற்றும் வேறுபாடு இரண்டுமில்லை, 4 உடன்படுகிறேன், 5 உறுதியாக உடன்படுகிறேன் ஆகியவற்றைப் பயன்படுத்தி குறிக்கவும்.

| | நீங்கள் … | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| A.7.1 | உங்களுடைய பால் பண்ணையிலிருந்து பெறப்படும் மொத்த வருமானம் குறித்து திருப்தியடைகிறீர்கள் | □ | □ | □ | □ | □ |
| A.7.2 | பால் பண்ணையிலிருந்து கிடைக்கும் வருமானம் உங்களுடைய குடும்பத்தின் அனைத்து தேவைகளையும் பூர்த்தி செய்ய போதுமானது என்பதில் திருப்தி அடைகின்றீர்கள் | □ | □ | □ | □ | □ |
| A.7.3 | பால் வியாபாரத்திலிருந்து பெறும் ஒட்டுமொத்த இலாபம் குறித்து திருப்தியடைகின்றீர்கள் | □ | □ | □ | □ | □ |

| | | | | | | |
|---|---|---|---|---|---|---|
| A.7.4 | பால்ப்பண்ணை நடவடிக்கைகளின் விளைவாக இருக்கின்ற உங்களுடைய வாழ்க்கைத் தரத்தில் திருப்தி அடைகின்றீர்கள் | □ | □ | □ | □ | □ |
| A.7.5 | உங்கள் பிள்ளைகள் பெற்றுக்கொள்ளும் கல்வித்தரத்தில் திருப்தியடைகின்றீர்கள் | □ | □ | □ | □ | □ |
| A.7.6 | பண்ணை நடவடிக்கைகள் காரணமாக சமூகத்திலிருந்து கிடைக்கும் அங்கீககாரம் தொடர்பில் திருப்தியடைகிறீர்கள் | □ | □ | □ | □ | □ |
| A.7.7 | கழிவுகளை அகற்ற முறையான முறைமையை கொண்டிருக்கவில்லை | □ | □ | □ | □ | □ |
| A.7.8 | திண்மக் கழிவுகளை விவசாய நடவடிக்கைகளுக்கு பயன்படுத்துகின்றீர்கள் (சக பண்ணையாளர்களுக்கு விற்பதோ ்இலவசமாக வழங்குவதோ ஏற்றுக்கொள்ளலாம்) | □ | □ | □ | □ | □ |
| A.7.9 | காற்று மாசுபாட்டைக் குறைப்பதற்கான குறிப்பிட்ட திட்டம் உங்களிடம் இல்லை (பின்வருவனவற்றைக் கருத்தில் கொண்டு, ஒட்டுமொத்த பதிலை வழங்கவும்: கால்நடை கொட்டகையை வழக்கமாக சுத்தம் செய்தல், உரம் தயாரித்தல் மற்றும் மூடப்பட்ட சேமிப்பு வசதிகளைப் பயன்படுத்துதல், பசுக்களின் ஊட்டச்சத்து தேவைகளுக்கு ஏற்ப தீவனப் பங்கீடுகளை சரிசெய்தல், உள்ளூரில் எளிதில் ஜீரணிக்கக்கூடிய தீவனப் பயிர்களைப் பயன்படுத்துதல்) | □ | □ | □ | □ | □ |

A. 8 கீழே உள்ள ஒவ்வொரு கூற்றுக்கும், தயவுசெய்து பின்வரும் அம்சங்களில் உங்கள் திறனை (x) 1 மிகவும் குறைவு, 2 குறைவு, 3 குறைவு அல்லது உயர்ந்தது அல்ல, 4 உயர்ந்தது மற்றும் 5 மிக உயர்ந்தது என மதிப்பிடவும்.

| | நீங்கள் … | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| A.8.1 | உங்களது பால் பதனிடும் கம்பனி வழங்கிய பயிற்சித்திட்டத்திலிருந்த கற்றுக்கொண்டவற்றை நடைமுறைப்படுத்த முடிகிறது | □ | □ | □ | □ | □ |
| A.8.2 | பண்ணை விரிவாக்க சேவை அதிகாரிகளுடன் நெருங்கிய உறவைப் பேணுகின்றீர்கள் | □ | □ | □ | □ | □ |
| A.8.3 | பால் பதனிடும் நிறுவனத்தினால் எதிர்பார்க்கப்படும் வருடம் முழுவதிற்குமாக பாலின் அளவை விநியோகிக்க முடியும் | □ | □ | □ | □ | □ |
| A.8.4 | பாலின் தர குறித்துரைப்புக்களை திருப்திப்படுத்த முடியும் | □ | □ | □ | □ | □ |

## முக்கிய கேள்வித்தாள்- பகுதி B

(தயவுசெய்து பண்ணையாளருக்கு பின்வரும் கேள்விகளைப் படித்து, பண்ணையாளர் அளித்த சரியான பதிலை எழுதவும்)

**உங்களுடைய பால் பண்ணை உற்பத்தி, பால் பதனிடும் நிறுவனம், பண்ணை நடைமுறைகள் மற்றும் சவால்கள் பற்றிய பின்வரும் கேள்விகளுக்கு பதில் அளிக்கவும்.**

B.1 நீங்கள் எவ்வளவு காலமாக பால் பண்ணை வியாபாரத்தில் ஈடுபட்டு வருகின்றீர்கள்? ................. ஆண்டுகள்.

B.2 உங்களுடைய பண்ணையின் அளவு என்ன? ......................... பரப்பு

B.3 உங்களுடைய கால்நடைகளின் அளவு எவ்வளவு? ......... பசுக்கள்; உள்ளூர் இனம் ........ + இறக்குமதி செய்யப்பட்ட இனம் ....... + கலப்பு இனம் ............

B.4 நீங்கள் பயன்படுத்தும் பால் பண்ணை முகாமைத்துவ முறைமை என்ன?

- □ (a). தீவிரமான
- □ (b). அரை-தீவிரமான
- □ (c). விரிவான

B.5 உங்களுடைய பண்ணையின் பால் உற்பத்தி அளவு எவ்வளவு?

a) காலை ................ லீட்டர்/நாள்
b) மாலை ................ லீட்டர்/நாள்

B.6 உற்பத்திக்கான சராசரி கிரயம் என்ன?

உள்ளீடுகள் ரூபா…………+ கூலிகள் ரூபா…………+ ஏனையவை ரூபா………= மொத்தம் ரூபா……………..

B.7 பாலுக்கு நீங்கள் பெறும் சராசரி விலை என்ன?

விலை ………….. ஒரு லீட்டருக்கு

B.8 உங்கள் கால்நடையின் உணவு வகை என்ன? *(இந்தக் கேள்விக்கு பல பதில்கள் இருக்கலாம் எனவே பொருத்தமானவற்றை தெரிவுசெய்யவும்)*

- □ (a). சொந்த மேய்ச்சல் நிலம்
- □ (b). பொது மேய்ச்சல் நிலம்
- □ (c). சந்தையில் இருந்து தயாரிக்கப்பட்ட உடனடி தீவனங்கள்
- □ (d). பசுக்களுக்கான கனிப்பொருள் தீவனங்கள்
- □ (e). வெட்டுப் புல்
- □ (f). ஏனையவை ………………..

B.9 வருடத்திற்கு சராசரி பாலுற்பத்தி நாட்கள் எத்தனை? ……………….. நாட்கள்

B.10 அடுத்த 3 ஆண்டுகளில் பால் உற்த்தியை அதிகரிக்க திட்டமிட்டுள்ளீர்களா? □ ஆம் □ இல்லை
உங்களுடைய பதில் ஆம் எனில் B.11 க்கு செல்லவும், இல்லையெனில் B.12 க்கு செல்லவும்

B.11 அடுத்த மூன்று ஆண்டுகளில் உங்களின் உத்தேச பால் உற்பத்தியின் அளவு எவ்வளவு?

| கணிப்பு | வருடம் | | |
|---|---|---|---|
| | 2024 | 2025 | 2026 |
| ஒரு நாளைக்கு லீட்டர் | | | |

B.12 பால் பதப்படுத்துபவரின் விரிவாக்க அலுவலர்கள் உங்கள் பண்ணைக்குச் சென்று உங்கள் பால் பதப்படுத்துபவரால் ஏற்பாடு செய்யப்பட்ட அழைக்கப்பட்ட அமர்வுகளில் பங்கேற்கும்போது அவர்களால் வழங்கப்படும் பயிற்சிக்கு மேலதிகமாக நீங்கள் ஏதேனும் கூடுதல் பயிற்சியைப் பெற்றிருக்கிறீர்களா? □ ஆம் □ இல்லை

B.13 நீங்கள் பாலை சேமிக்கின்றீர்களா? □ ஆம் □ இல்லை உங்களுடைய பதில் ஆம் எனில் B.14 க்கு செல்லவும், இல்லையெனில் B.15 க்கு செல்லவும்

B.14 நீங்கள் பயன்படுத்தும் பால் சேமிப்பு முறை என்ன?

□ (a) இரவு முழுவதும் குளிர்சாதனப் பெட்டியில் சேமித்தல்

□ (b) வேறு இடத்தில் சேமித்தல் (தயவுசெய்து குறிப்பிடவும்) …………………………………

B.15 நீங்கள் உற்பத்தி செய்யும் அனைத்து பாலையும் விற்பனை செய்கிறீர்களா? □ ஆம் □ இல்லை உங்களுடைய பதில் 'இல்லை' எனில் B.16 க்கு செல்லவும், இல்லையெனில் B.17 க்கு செல்லவும்

B.16 நீங்கள் விற்பனை செய்யும் பாலின் அளவு எவ்வளவு? ………………….லீட்டர்/நாள்

B.17 பால் பதனிடும் நிறுவனத்திற்கு பால் வழங்க நீங்கள் பயன்படுத்தும் போக்குவரத்து முறை என்ன? *(தயவுசெய்து மிகப்பொருத்தமானதை தேர்ந்தெடுக்கவும்)*

- □ (a) பால் பதனிடும் நிறுவனத்தின் சேகரிப்பு/ குளிரூட்டல் மையத்திற்கு நீங்கள் பாலை வழங்குகிறீர்கள்
- □ (b) நீங்கள் விவசாய சம்மேளனத்திற்கு பாலை வழங்குகிறீர்கள்(அதிலிருந்து பால் உற்பத்தி நிறுவனம் பாலை சேகரிக்கிறது)
- □ (c) நீங்கள் ஒரு இடைத்தரகு முகவருக்கு விற்கிறீர்கள்
- □ (d) உங்களுடைய பால் பதனிடும் நிறுவனத்தின் வாகனம் உங்கள் பண்ணை வாசலில் பாலை எடுக்கும்
- □ (e) நீங்கள் மூன்றாம் தரப்பினருக்கு பாலை விற்கிறீர்கள் (உ+ம் பால் கூட்டுறவு சங்கம்)

B.18 நீங்கள் விவசாய சம்மேளன அங்கத்தவரா? □ ஆம் □ இல்லை உங்களுடைய பதில் 'ஆம்' எனில் B.19 க்கு செல்லவும், இல்லையெனில் B.20 க்கு செல்லவும்

B.19 நீங்கள் அங்கத்தவராக இருக்கும் விவசாய சம்மேளனங்கள் யாவை? (இந்தக் கேள்விக்கு பல பதில்களும் இருக்கலாம் மற்றும் தெரிவுசெய்யவும்)

□ (a) விவசாய சம்மேளன சங்கம் (கிராமத்தில்)
□ (b) கூட்டுறவு சங்கம்
□ (c) உங்களுடைய பால் கொள்வனவாளரின் உழவர் சங்கம்
□ (d) மற்றவை (குறிப்பிடவும்) ................................................

B.20 பால் பண்ணையைத் தவிர வேறு ஏதேனும் வருமான ஆதாரங்கள் உங்களிடம் உள்ளதா? □ ஆம் □ இல்லை

உங்களுடைய பதில் 'ஆம்' எனில் B.21 க்கு செல்லவும், இல்லையெனில் B.22 க்கு செல்லவும்

B.21 உங்களுடைய ஆண்டு வருமானத்தில் பண்ணை தவிர மற்றைய வருமான ஆதாரங்களின் பங்களிப்பு என்ன? ..........%

B.22 உங்களுடைய உற்பத்தியின் 75% க்கும் அதிகமான பால் உற்பத்தியில் மேற்குறிப்பிட்ட (A.2) நிறுவனங்களிலிருந்து உங்கள் விருப்பமான பால் பதனிடும் நிறுவனமாக....................................................... ற்கு விநியோகிக்க ஏன் தெரிவுசெய்தீர்கள்? (இந்தக் கேள்விக்கு பல பதில்களும் இருக்கலாம் பதிலளிக்கும்போது)
□ (a). பாலுக்கான சிறந்த விலை
□ (b). பண்ணைக்கருகில் சேகரிப்புமையம் உள்ளமை
□ (c). நீண்ட கால உறவு
□ (d). நான் பெறும் நன்மைகள்
□ (e). பால் எளிதில் நிராகரிக்கப்படுவதில்லை
□ (f). பண்ணை வாசலில் இருந்து பால் சேகரிக்கப்படுகின்றது
□ (g). சரியான நேரத்தில் பணம் செலுத்துதல்
□ (h). வேறு ஏதேனும் (தயவுசெய்து குறிப்பிடவும்) ........................................

B.23 அடுத்த 12 மாதங்களில் உங்களுடைய பால் கொள்வனவாளரை மாற்ற திட்டமிட்டுள்ளீர்களா?

□ (a). மிகவும் சாத்தியமில்லை
□ (b). வாய்ப்பில்லை
□ (c). சாத்தியமும் வாய்ப்பும் இல்லை
□ (d). வாய்ப்புள்ளது
□ (e). மிகவும் வாய்ப்புள்ளது.
பதில் வாய்ப்புள்ளது, மிகவும் வாய்ப்புள்ளது எனில் B.24 க்கு செல்லவும், இல்லையெனில் B.25 க்கு செல்லவும்

B.24 மற்றொரு பால் கொள்வனவாளரிற்கு மாறுவதற்கு முக்கிய காரணம் என்ன? (மிகவும் பொருத்தமான காரணத்தைத் தேர்ந்தெடுக்கவும்)

□ (a). பாலுக்கு சிறந்த விலை
□ (b). சேகரிப்புமையம் அருகாமையில்
□ (c). சரியான நேரத்தில் பணம் செலுத்துவதில் நம்பகத்தன்மை
□ (d). சிறந்த போக்குவரத்து வசதி
□ (e). பால் நிராகரிக்கப்படாமைக்கான வாய்ப்பு மிக அதிகம்
□ (f). ஏனைய நன்மைகள்

B.25 உங்கள் வணிகத்திற்கு ஏற்படும் முக்கிய சவால்கள் குறித்த பின்வரும் அறிக்கைகளுடன் உங்கள் உடன்பாட்டு அளவை மிகக் குறைவு, குறைவு, குறைவு அல்லது அதிகமல்ல , அதிகம் மற்றும் மிக அதிகம் ஆகியவற்றைப் பயன்படுத்திக் குறிக்கவும். 1. மிக குறைவு, 2. குறைவு, 3. குறைவும் இல்லை அதிகமுமில்லை, 4. அதிகம், 5. மிக அதிகம்

| | நீங்கள் எதிர்கொள்கின்றீர்கள் | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| B.25.1 | வரையறுக்கப்பட்ட நிலப்பரப்பு | □ | □ | □ | □ | □ |
| B.25.2 | சரியான நிதி உதவி இன்மை | □ | □ | □ | □ | □ |
| B.25.3 | கோவிட்-19 தொற்று | □ | □ | □ | □ | □ |
| B.25.4 | தீவனத்தின் அதிக விலை | □ | □ | □ | □ | □ |
| B.25.5 | வரையறுக்கப்பட்ட அரசாங்க உதவி | □ | □ | □ | □ | □ |
| B.25.6 | நாட்டின் தற்போதைய பொருளாதாரச் சூழல் (உ.ம் மிக அதிக பணவீக்கம்) | □ | □ | □ | □ | □ |
| B.25.7 | சமூகக் காரணிகள் (அயலவர்களின் ஆதரவு இன்மை, விவசாயத்திற்கான பாராட்டு இன்மை, அங்கீகாரமின்மை) | □ | □ | □ | □ | □ |
| B.25.8 | நல்ல மாட்டு இனங்கள் குறைவாகவே கிடைக்கும் | □ | □ | □ | □ | □ |
| B.25.9 | பால் சேகரிப்பு மையத்திற்கு கொண்டு செல்வதில் சிரமம் | □ | □ | □ | □ | □ |
| B.25.10 | குறைந்தளவு புல் கிடைக்கும் | □ | □ | □ | □ | □ |
| B.25.11 | ஏனையவை (குறிப்பிடவும்)........................................... | □ | □ | □ | □ | □ |

**நிறைவு**

**உங்கள் நேரத்திற்கும் தகவல் பகிர்வுக்கும் நன்றி. எதிர்காலத்தில் தேவைப்பட்டால் மேலும் தகவல்களை தெளிவுபடுத்த மீண்டும் உங்களைத் தொடர்பு கொள்ள உங்கள் அன்பான அனுமதியைக் கேட்க விரும்புகிறேன்**

## Appendix I: Information sheet

MASSEY UNIVERSITY
COLLEGE OF SCIENCES
TE WĀHANGA PŪTAIAO

# A Model on Sustainable Farmer Development in Developing Counties: A Test on Dairy Value Chains

INFORMATION SHEET

My name is Leeza De Silva. I am a PhD researcher in Logistics and Supply Chain Management. I am affiliated to the School of Food and Advanced Technology, Massey University, New Zealand. I am also a Senior Lecturer at University of Peradeniya and is currently on overseas study leave to read my PhD. The success of PhD would rely on the data I collect from the dairy farmers in Sri Lanka.

As a dairy farmer, you are cordially invited to take part in my study on sustainable farmer development in the fresh milk value chain of Sri Lanka. This Information Sheet is a brief about me (the principal research investigator) and my research study.

Since I am away from Sri Lanka my Research Assistant will speak to you today on behalf of me.

My study attempts to explain how farmer development initiatives implemented by a dairy company improves farmer's capability, relationships the farmer has with the dairy company, and above all, the socioeconomic status and ecological footprint the farmers. If you agree to take part in my study, you will be asked to sign the Consent Form on the last page of this document. This is because without your consent, I am not allowed to interview you, based on the ethics rules imposed upon me by Massey University. You will be given a copy of both the Participant Information Sheet and the Consent Form for your records.

I wish to assure you that the information you provide will be used only for research purposes and will not be disclosed to third party other than by two supervisors. Further, the information/data I collect will be destroyed upon successful completion of my study.

You are under no obligation to formally accept this invitation to participate. However, if you decide to participate, you have the right to: decline in answering any question that I ask, withdraw from the study at any given point of time, ask any questions about the study any time during the interview (or even later), decline my request to record the interview in full or in parts. Further, I assure that my study has been peer reviewed and judged to be low risk.

Thank you in advance for your help.

Yours Sincerely

Leeza De Silva
PhD Candidate in Supply Chain Management
School of Food and Advanced Technology
Massey University
Palmerston North 4442
New Zealand
Email: Leeza.DeSilva.1@uni.massey.ac.nz
T: +64[redacted] (New Zealand); M: +94[redacted] (Sri Lanka)

Cc:

Dr Nihal Jayamaha (N.P.Jayamaha@massey.ac nz)

Dr Elena Garnevska (E.V.Garnevska@massey.ac.nz)

## Appendix J: Participant consent form

MASSEY UNIVERSITY
COLLEGE OF SCIENCES
TE WĀHANGA PŪTAIAO

***A MODEL ON SUSTAINABLE SUPPLIER DEVELOPMENT IN DEVELOPING COUNTIES: A TEST ON DAIRY VALUE CHAINS***

**PARTICIPANT CONSENT FORM**

I have read or have been read to me in my first language, and I understand the Information Sheet attached as Appendix I. The details of the study have been explained to me. I shall answer the questions to the best of my knowledge, and I understand that I may ask further questions at any time. I have been given sufficient time to consider whether to participate in this study or not. Further, I understand participation is voluntary and that I may withdraw from the study at any time.

1. I agree/do not agree to the interview being sound recorded.
2. I agree/do not agree to the interview being image recorded.
3. I agree to participate in this study under the conditions set out in the Information Sheet.

**Declaration by Participant:**

I ____________________________________________ hereby consent to take part in this study.

**Signature:** ________________________ Date: ________________

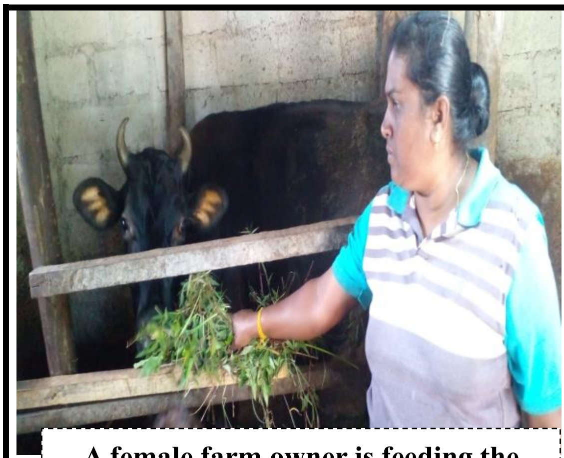
**Declaration by member of research team:**

I have given a verbal explanation of the research project to the participant and have answered the participant's questions about it. I believe that the participant understands the study and has given informed consent to participate.

Researcher's /Research Assistant's name: ____________________________________________

**Signature:** ________________________ Date: ________________

**Appendix K: A collection of photographs that have been captured during the field work (including both Phase I and Phase II)**

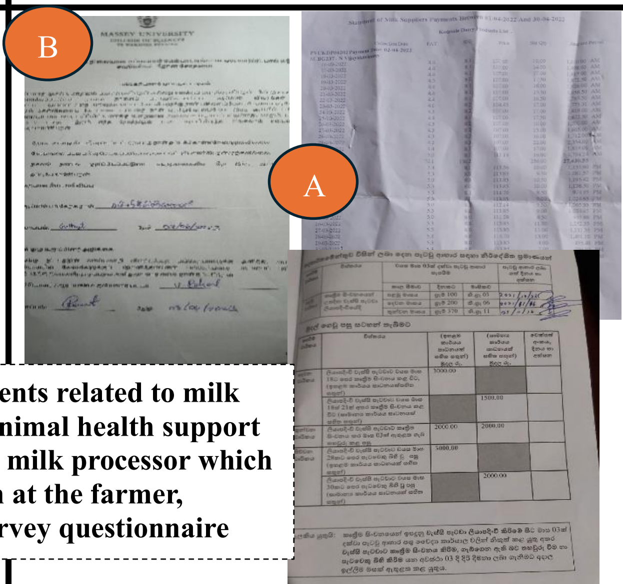


A female farm owner is feeding the cow in the cattle shed

Rural dairy farmer and his cattle shed

Milk collection and chilling at the Processor's collecting centre

A light truck being loaded for milk




(A) A few documents related to milk transactions, animal health support provided by the milk processor which maintain at the farmer,
(B) A sample survey questionnaire

## Appendix L: Research ethic approval

Date: 12 August 2021

Dear Leeza De Silva

Re: Ethics Notification - **4000024882 - A Model to Improve the Fresh Milk Formal Dairy Value Chainin Sri Lanka**

Thank you for your notification which you have assessed as Low Risk.

Your project has been recorded in our system which is reported in the Annual Report of the MasseyUniversity Human Ethics Committee.

The low risk notification for this project is valid for a maximum of three years.

If situations subsequently occur which cause you to reconsider your ethical analysis, please contact aResearch Ethics Administrator.

Please note that travel undertaken by students must be approved by the supervisor and the relevant Pro Vice-Chancellor and be in accordance with the Policy and Procedures for Course -Related Student Travel Overseas. In addition, the supervisor must advise the University's Insurance Officer.

**A reminder to include the following statement on all public documents:**

*"This project has been evaluated by peer review and judged to be low risk. Consequently, it has not beenreviewed by one of the University's Human Ethics Committees. The researcher(s) named in this document are responsible for the ethical conduct of this research.*

*If you have any concerns about the conduct of this research that you want to raise with someone otherthan the researcher(s), please contact Professor Craig Johnson, Director - Ethics, telephone 06 3569099 ext 85271, email humanethics@massey.ac.nz."*

Please note, if a sponsoring organisation, funding authority or a journal in which you wish to publish requires evidence of committee approval (with an approval number), you will have to complete the application form again, answering "yes" to the publication question to provide more information for one of the University's Human Ethics Committees. You should also note that such an approval can only be provided prior to the commencement of the research.

Yours sincerely

Human Ethics Low Risk notification

Professor Craig Johnson
Chair, Human Ethics Chairs' Committee and Director (Research Ethics

## Appendix M: Statement of Contribution-Doctorate with Publications/Manuscripts

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

GRADUATE RESEARCH SCHOOL

# STATEMENT OF CONTRIBUTION
# DOCTORATE WITH PUBLICATIONS/MANUSCRIPTS

We, the student and the student's main supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the student's contribution as indicated below in the Statement of Originality.

| | | | |
|---|---|---|---|
| Student name: | Hearath Leeza Marlin DeSilva | | |
| Name and title of main supervisor: | Dr. Nihal Jayamaha | | |
| In which chapter is the manuscript/published work? | 3 | | |

Describe the contribution that the student and members of the supervisory team have made to the manuscript/published work:[1]

Leeza De Silva: Conceptualization, writing the original draft and editing (85% contribution to the total).

Nihal Jayamaha: Supervision, refining the conceptualization, reviewing and editing (10% contribution to the total).

Elena Garnevska: Supervision, reviewing and editing (5% contribution to the total)

Please select one of the following three options:

(●) **The manuscript/published work is published or in press**

Please provide the full reference of the research output:

De Silva, L., Jayamaha, N., & Garnevska, E. (2023). Sustainable Farmer Development for Agri-Food Supply Chains in Developing Countries. Sustainability, 15(20), 15099. https://www.mdpi.com/2071-1050/15/20/15099

( ) **The manuscript is currently under review for publication**

Please provide the name of the journal:

( ) **It is intended that the manuscript will be published, but it has not yet been submitted to a journal**

| | | | |
|---|---|---|---|
| Student's signature: | Herath Leeza Marlin DeSilva — Digitally signed by Herath Leeza Marlin DeSilva Date: 2025.01.23 16:56:48 +13'00' | Main supervisor's signature: | Nihal Jayamaha — Digitally signed by Nihal Jayamaha Date: 2025.01.23 17:56:08 +13'00' |

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UNIVERSITY OF NEW ZEALAND

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| | |
|---|---|
| Student name: | Hearath Leeza Marlin DeSilva |
| Name and title of main supervisor: | Dr. Nihal Jayamaha |
| In which chapter is the manuscript/published work? | 4 |

Describe the contribution that the student and members of the supervisory team have made to the manuscript/published work:[1]

Leeza De Silva: Conceptualization, fieldwork, qualitative data analysis, writing the paper (85% contribution)

Nihal Jayamaha: Supervision, reviewing and editing (5% contribution).

Elena Garnevska: Supervision, reviewing and editing (10% contribution).

Please select one of the following three options:

- ○ **The manuscript/published work is published or in press**
  Please provide the full reference of the research output:

- ◉ **The manuscript is currently under review for publication**
  Please provide the name of the journal:
  Journal of Agricultural Sciences- Sri Lanka

- ○ **It is intended that the manuscript will be published, but it has not yet been submitted to a journal**

| | | | |
|---|---|---|---|
| Student's signature: | Herath Leeza Marlin DeSilva — Digitally signed by Herath Leeza Marlin DeSilva Date: 2025.01.23 16:56:48 +13'00' | Main supervisor's signature: | Nihal Jayamaha — Digitally signed by Nihal Jayamaha Date: 2025.01.23 18:19:20 +13'00' |

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|---|---|
| Student name: | Hearath Leeza Marlin DeSilva |
| Name and title of main supervisor: | Dr. Nihal Jayamaha |
| In which chapter is the manuscript/published work? | 5 |

Describe the contribution that the student and members of the supervisory team have made to the manuscript/published work:[1]

Leeza De Silva: Conceptualization, fieldwork, data analysis, and writing the bulk of the paper (80% contribution).

Nihal Jayamaha: Supervision, verification of the analysis and correcting, writing few parts and editing (15% contribution).

Elena Garnevska: Supervision, reviewing and editing (5% contribution).

Please select one of the following three options:

- ○ **The manuscript/published work is published or in press**
  Please provide the full reference of the research output:
- ◉ **The manuscript is currently under review for publication**
  Please provide the name of the journal:
  International Journal of Productivity and Performance Management
- ○ **It is intended that the manuscript will be published, but it has not yet been submitted to a journal**

| | | | |
|---|---|---|---|
| Student's signature: | Herath Leeza Marlin DeSilva — Digitally signed by Herath Leeza Marlin DeSilva Date: 2025.01.23 16:56:48 +13'00' | Main supervisor's signature: | Nihal Jayamaha — Digitally signed by Nihal Jayamaha Date: 2025.01.23 18:27:48 +13'00' |

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1

*Doctoral Research Committee*
*May 2023*

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

GRADUATE RESEARCH SCHOOL

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# DOCTORATE WITH PUBLICATIONS/MANUSCRIPTS

We, the student and the student's main supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the student's contribution as indicated below in the Statement of Originality.

| | |
|---|---|
| Student name: | Hearath Leeza Marlin DeSilva |
| Name and title of main supervisor: | Dr. Nihal Jayamaha |
| In which chapter is the manuscript/published work? | 6 |

Describe the contribution that the student and members of the supervisory team have made to the manuscript/published work:[1]

Leeza De Silva: Conceptualization, fieldwork, data analysis, and writing the paper (80% contribution).

Nihal Jayamaha: Supervision, verification of the analysis, reviewing and editing (10% contribution).

Elena Garnevska: Supervision, reviewing and editing (10% contribution).

Please select one of the following three options:

○ **The manuscript/published work is published or in press**

Please provide the full reference of the research output:

◉ **The manuscript is currently under review for publication**

Please provide the name of the journal:

Benchmarking: An International Journal

○ **It is intended that the manuscript will be published, but it has not yet been submitted to a journal**

| | | | |
|---|---|---|---|
| Student's signature: | Herath Leeza Marlin DeSilva — Digitally signed by Herath Leeza Marlin DeSilva Date: 2025.01.23 16:56:48 +13'00' | Main supervisor's signature: | Nihal Jayamaha — Digitally signed by Nihal Jayamaha Date: 2025.01.23 18:36:57 +13'00' |

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GRADUATE RESEARCH SCHOOL

# STATEMENT OF CONTRIBUTION DOCTORATE WITH PUBLICATIONS/MANUSCRIPTS

| | | | |
|---|---|---|---|
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| Student name: | Hearath Leeza Marlin DeSilva | | |
| Name and title of main supervisor: | Dr. Nihal Jayamaha | | |
| In which chapter is the manuscript/published work? | 7 | | |
| Describe the contribution that the student and members of the supervisory team have made to the manuscript/published work:[1]<br>Leeza De Silva: Conceptualization, fieldwork, data analysis, and writing the paper (80% contribution).<br>Nihal Jayamaha: Supervision, verification of the analysis and correcting, writing few parts and editing (15% contribution).<br>Elena Garnevska: Supervision, reviewing and editing (5% contribution). | | | |
| Please select one of the following three options: | | | |
| ○ **The manuscript/published work is published or in press**<br>Please provide the full reference of the research output: | | | |
| ◉ **The manuscript is currently under review for publication**<br>Please provide the name of the journal:<br>Contemporary South Asia | | | |
| ○ **It is intended that the manuscript will be published, but it has not yet been submitted to a journal** | | | |
| Student's signature: | Herath Leeza Marlin DeSilva — Digitally signed by Herath Leeza Marlin DeSilva Date: 2025.01.23 16:56:48 +13'00' | Main supervisor's signature: | Nihal Jayamaha — Digitally signed by Nihal Jayamaha Date: 2025.01.23 18:40:40 +13'00' |
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