

**An Empirical Investigation of Supply Chain Sustainability:
Practice, Pressure, and Performance within Large and
Medium Manufacturing Industries in Ethiopia**

MEBRAT AREGAWI WELDEMICHAEL

**A Thesis Submitted In Partial Fulfilment of the Requirements of Liverpool
John Moores University for the Degree of Doctor Philosophy**

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DECLARATION

I, **Mebrat Aregawi Weldemichael**, do hereby declare that the thesis entitled “Supply Chain Sustainability Inquiry into Practice, Pressure, and Performance among Large and Medium Manufacturing Industries in Ethiopia”, submitted to the Faculty of Engineering and technology, Liverpool John Moores University, in partial fulfilment of the requirement of a Doctor of Philosophy in Logistics and Supply Chain Management, is my original work. It has not been presented for the award at any other university or institution. Moreover, all sources of material used for this thesis have been duly acknowledged.

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DEDICATION

To my beloved late father, Aregawi Weldemichael, and late brother, Mulugeta Aregawi

Though you are no longer here, your love, strength, and spirit have remained with me every step of this journey. Your memory has been a constant source of inspiration, pushing me to persevere, to grow, and to become a better person, just as you always wished to see me. This work is dedicated to you with deep love, enduring respect, and an unspoken promise to carry your legacy forward.

Mebrat Aregawi Weldemichael

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ABSTRACT

This study aimed to develop a standardized framework for assessing and measuring SSCM performance. It also sought to examine the role of social, environmental, and economic SSC practices in enhancing the performance of large and medium-sized manufacturing firms in Ethiopia. The conceptual framework is theoretically underpinned by the Triple E concept, which stresses the incorporation of economic, environmental, and social sustainability practices. The Triple E concept provides the theoretical justification by arguing that long-term organizational success depends on balancing economic viability, environmental stewardship, and social responsibility rather than focusing solely on financial outcomes. Accordingly, the conceptual framework assumes that integrating these sustainability practices enhances overall sustainable performance in Ethiopian manufacturing firms. The study was shaped by a pragmatist ontological perspective, which influenced the choice of methodology. Pragmatism approach enabled the adoption of a mixed-methods strategy, allowing for the combination of quantitative and qualitative data to deliver a thorough understanding of the research issue and effectively address the research questions.

The study specifically focused on the medium- and large-scale manufacturing industries and industry parks located in major Ethiopian cities. A total of 86 manufacturing companies participated in the survey, and questionnaires, structured interviews, and observation were the primary data collection instruments. The data analysis structure includes descriptive, factor, and inferential analyses. This study has employed EFA to identify drivers and barriers of SSC practice. Moreover, to investigate the determinants of SSC performance, both OLS and the logit model have been employed. The findings show that SSC practices adoption is increasing in Ethiopian manufacturing, but it is uneven and fragmented. The findings further indicate that export-oriented manufacturing firms have implemented SSC practices largely in response to external pressures, including regulatory requirements, customer expectations, and international market standards. In contrast, firms serving primarily domestic markets demonstrated lower levels of SSC practice adoption and weaker sustainability performance, largely due to limited government enforcement and reduced pressure from other external stakeholders.

Regarding the drivers and barriers of the sustainable supply chain, top management commitment, employee involvement, government regulation, and customer demand are the major drivers of sustainable practice. The cost of SSC implementation and the absence of knowledge and training are the major barriers to adopting a SSC in Ethiopian manufacturing. The OLS estimator used in the linear regression model indicates that the gross profit of the companies surveyed increases with the presence of environmental policy, EMS certifications, and CSR policy. These variables are statistically significant and positively associated with companies' gross profit. This study introduces a comprehensive conceptual framework for evaluating and measuring SSCM performance. The framework is developed to enable the large and medium-sized Ethiopian manufacturing firms to adopt SSC practices and measure their performance.

TABLE OF CONTENTS

LIST OF ACRONYMS	vi
LIST OF TABLES	vii
LIST OF FIGURES	viii
CHAPTER ONE	1
INTRODUCTION.....	1
1.1 Introduction.....	1
1.2 Overview of the Manufacturing Sector in Ethiopia.....	2
1.3 Statement of the Problem	5
1.4 Research Gap	8
1.4.1 Summary of the key research gaps identified.....	11
1.6 Novelties and Contributions of the Study	12
1.7 Scope of the Study.....	19
1.8 Structure of the Research.....	19
CHAPTER TWO	21
LITERATURE REVIEW	21
2.1 Introduction.....	21
2.2 Conceptual Frameworks	21
2.2.1 Conceptualisation of Sustainable Supply Chain Management.....	22
2.2.2. Resource-Based View.....	26
2.2.3. Stakeholders Theory	28
2.2.4. Institutional Theory	29
2.2.5. Transaction Cost Economics.....	31
2.3 Dimensions of Sustainable Supply Chain Management Practice	32
2.3.1 Environmental Sustainability	32
2.3.2 Economic Sustainability	33
2.3.3 Empowerment and Social Sustainability	35
2.4 Sustainable Supply Chain Practices in Africa.....	37
2.4.1 The Impact of Sustainable Supply Chains on African Economies	37
2.4.2 Africa's Emergence as a Key Player in the Global Supply Chains	38
2.4.3 Challenges in Implementing Sustainable Supply Chain Practices in the African Manufacturing Industry.....	39
2.5 Empirical Analysis.....	44
2.5.1 Drivers of Sustainable Supply Chain	44
2.5.1.1 External Drivers.....	45

2.5.1.2 Internal Drivers.....	46
2.6 Sustainable Supply Chain Management and Firm Performance.....	49
2.7 Ethiopian Laws and Regulations Pertinent to Sustainable Supply Chain Practice as Drivers Specific to Ethiopia	50
2.7.1 Review of Environmental Impact Assessment Proclamation No. 299/2002	50
2.7.2 Review of Ethiopian Labour Law Proclamation 1156/2019	51
2.7.3 Review of Ethiopia Investment Proclamation No. 1180/2020	52
2.7.4 Review of Environmental Pollution Control Proclamation No. 300/2002	54
2.7.5 Review of the Ethiopian Wildlife Development, Conservation, and Utilisation Proclamation No. 541/2007.....	55
2.7.6 Review of Ethiopian Renewable Energy Development Proclamation No. 810/2013...55	
2.7.7 Review of Evaluation of Ethiopian Public Procurement and Property Administration Proclamation No. 649/2009.....	57
2.7.8 Review of Ethiopian Trade Competition Proclamation No. 813/2013.....	57
2.8 Theoretical and Contextual Research Gaps.....	60
2.9 Theoretical Framework Development.....	61
2.9.1 Description of the Theoretical Framework.....	64
2.9.2 Dimensions of Sustainable Supply Chain Management Practice.....	64
2.9.3 Sustainable Supply Chain Management Drivers and Barriers	64
CHAPTER THREE	65
RESEARCH METHODOLOGY	65
3.1 Introduction.....	65
3.2 Research Purpose	66
3.3 Research Philosophy	66
3.4 Research Approach.....	66
3.5 Methodological Choice	67
3.6 Research Strategy	68
Analysis Sequence and Justification.....	70
3.7 Time Horizon.....	72
3.8 Data Collection	72
3.8.1 The Data Collection Tools and Process.....	72
3.8.1 Sampling Techniques and Sampling Size Selection	74
3.8.2 Study Area Selection and Justification	75
3.8.3 Sample Size	77
3.9 Data Analysis Structure.....	77
3.10 Framework Development and Approaches	81

CHAPTER FOUR.....	86
DATA COLLECTION AND ANALYSIS	86
4.1 Introduction.....	86
4.2 Data Presentations	86
4.3 Descriptive Analysis.....	86
4.3.1 Environmental Policy and Management System.....	87
4.3.3 Social Dimensions Practices	90
4.3.4 Supplier Integration.....	92
4.4 Drivers and Barriers of Sustainable Supply Chain Practice.....	93
4.4.1 Analysis of Drivers and Barriers of Sustainable Supply Chain Practice.....	93
4.5 Quantitative Environmental Sustainability Indicators	102
4.5.1 Energy Consumption Management.....	102
4.5.2 Water Management	106
4.5.3 Waste Management.....	106
4.6 Determinants of Sustainable Supply Chain Performance.....	107
4.6.1 Ordinary Least Squares as an estimator for the linear regression model	107
CHAPTER FIVE	110
DATA INTERPRETATION AND DISCUSSION.....	110
5.2.3 Social Dimensions Practices	115
5.2.4 Supplier Integration.....	120
5.3. Discussion on Drivers and Barriers of Sustainable Supply Chain Practice	122
5.4 Discussion of the Quantitative Environmental Sustainability Indicators Result.....	131
5.4.2 Water Management	133
5.4.3 Waste Management.....	133
5.6 The Logit Model.....	137
CHAPTER SIX	143
FRAMEWORK DEVELOPMENT AND VALIDATION	143
6.1 Introduction to the Validated Framework	143
6.2 Framework Validation Based on DMAIC	143
6.3 Description of the Validated Framework	147
CHAPTER SEVEN.....	150
CONCLUSIONS AND RECOMMENDATION	150
7.1 Conclusion	150
7.1.3 Determinants of Sustainable Supply Chain Performance.....	152
7.2 Recommendation.....	154

7.2.1 Specific Recommendations.....	154
7.2.2 To Manufacturing Industries.....	158
7.2.3 To Government	159
8 Limitations and Future Research Suggestion	161
8.1 Limitations.....	161
8.2 Future Research	161
Reference	162
APPENDICES	180
Appendix 1- Questionnaire	181
Appendix 2: Surveyed manufacturing industries	200
Appendix 3: Letter of support for data collection.....	Error! Bookmark not defined.

LIST OF ACRONYMS

CDP - Carbon Disclosure Project
CEO - Chief Executive Officer
CSR - Corporate Social Responsibility
ECOSOC - Economic and Social Council
EEA - Ethiopian Energy Authority
EFA - Exploratory Factor Analysis
EIA - Environmental Impact Assessment
EIC - Ethiopia Investment Commission
EMS - Environmental Management System
EP - Economic Performance
ESSP - Externally Influencing Social Sustainability Practices
FDRE - Federal Democratic Republic of Ethiopia
FGD - Focus Group Discussion
GDP - Gross Domestic Product
GHG - Greenhouse Gas
IPDC - Industrial Parks Development Corporation
ISO - International Organisation for Standardization
ISSP - Internally Influencing Social Sustainability Practices
KPIs - Key Performance Indicators
NBA - National Bank of Ethiopia
NDC - Nationally Determined Contributions
NGOs - Non-Governmental Organisations
NRBV - Natural Resource Based View
OH&S - Occupational Health and Safety
OHSAS - Occupational Health and Safety Assessment Series
OLS - Ordinary Least Squares
PPP - Public Private Partnership
QMS - Quality Management Systems
RBV - Resource-Based View
ROI - Return on Investment
SCI - Supply Chain Integration
SCM - Supply Chain Management
SSC - Sustainable Supply Chain
SSCM - Sustainable Supply Chain Management
SSCP - Sustainable Supply Chain Performance
TBL - Triple Bottom Line
TCE - Transaction Cost Economics
Triple E - Environmental, Economic, Empowerment
UNCITRAL - United Nations Commission on International Trade Law
UNDESA - United Nations Department of Economic and Social Affairs

LIST OF TABLES

Table 1 Growth and Percentage Distribution of the Manufacturing Sector.....	2
Table 2 Key findings from relevant studies on sustainable supply chain management ordered in reverse chronological order from newest to oldest	24
Table 3 Driver of Sustainability Practice.....	45
Table 4 Summary of Ethiopian Laws and Regulations Pertinent to Sustainable Supply Chain Practice	59
Table 5 Time Horizon	72
Table 6 Selected Ethiopian Industrial Parks and their Category, Location and Status	76
Table 7 Criteria for sample selection for the FGD	83
Table 8 Sustainability Supply Chain Management Process and the Environment	90
Table 9 Human Resource Practice	92
Table 10 Mean Result of the Supplier Integration	92
Table 11 Driving factors- Descriptive statistics.....	94
Table 12 Barrier Factors - Descriptive Statistics	94
Table 13 Driver Factors Matrix of Correlations.....	95
Table 14 Barrier Factors Matrix of Correlations	97
Table 15 Drivers Eigenvalue	98
Table 16 Barriers Eigenvalue	99
Table 17 Rotated factor loadings (pattern matrix) and unique variances for drivers	99
Table 18 Rotated factor loadings (pattern matrix) and unique variances for Barriers	101
Table 19 Energy Consumption Management Quantitative Indicators.....	102
Table 20 Water Management Quantitative Indicators	106
Table 21 Waste Management Quantitative Indicator	106
Table 22 Linear regression: Gross Profit	108
Table 23 Driver of Sustainable Supply Chain Practice	123
Table 24 Barriers to Sustainable Supply Chain Practice.....	128
Table 25 Common environmental certifications in Ethiopia.....	135
Table 26 Logistic Regression International Environmental Certification	138
Table 27 Corporate Social Responsibility Policy: logistics regression.....	140
Table 28 Summary of Framework Validation Based on DMAIC	146

LIST OF FIGURES

Figure 1 Sectoral growth and contribution to GDP in Ethiopia (2020/21–2023/24).....	5
Figure 2 Structure of the chapters	20
Figure 3 Sustainable Supply Chain Theoretical Framework (author's own development) 63	
Figure 4 The Research Onion (Saunders <i>et al.</i> , 2009)	65
Figure 5 Industry Parks Location (Source IPDC, 2024)	75
Figure 6 Company-level environmental policy	87
Figure 7 Responsible Body for Environmental Issues.....	87
Figure 8 Periodic monitoring and evaluation of environmental performance	88
Figure 9 Frequency of Assessing Risks Associated with the Environment	88
Figure 10 Objective and target to increase energy efficiency	89
Figure 11 Report GHG emissions to the Carbon Disclosure Project (CDP) or the public..	89
Figure 12 publicly setting energy use reduction targets.....	89
Figure 13 Formal Corporate Social Responsibility (CSR) Policy	90
Figure 14 Community engagement of the manufacturing firms	91
Figure 15 Certified to Health & Safety Standards (ISO 45001)	91
Figure 16 The existence of a trade union	92
Figure 17 Energy Consumption Quantitative Indicators.....	103
Figure 18 Energy consumptions	104
Figure 19 Waste Management among sectors.....	107
Figure 20 Main Drivers (Factor 1) of Sustainable Supply Chain Practice.....	124
Figure 21 Main Barriers to Sustainable Supply Chain Practice	129
Figure 22 Validated Framework - Supply Chain Sustainability Practice Guiding Framework	149

CHAPTER ONE

INTRODUCTION

1.1 Introduction

Global concerns over climate change, unsustainable use of natural resources, and economic slowdown are forcing businesses to reassess how they operate. Many business organisations of this time are incorporating the sustainability program into their supply chain including control of the Triple Bottom Line (hereafter referred to as TBL), i.e., economic, environmental, and social (empowerment) performance, this should in theory lead to a reduction of waste and creation of efficiency that lowers use of resources and costs, with the ultimate objective of preserving conditions to support future generations (Ahmad *et al.*, 2017; Geng *et al.*, 2017; Haskins *et al.*, 2018; Pagell & Wu, 2009; Gong *et al.*, 2019; Leitham & Beck 2023; Brandenburg & Rebs, 2015; Oberle *et al.*, 2019; Usman Ahmed *et al.*, 2022).

Sustainability is defined as “development that meets the needs of the present without compromising the ability of future generations to meet their needs” (Industry, Cable, Li, & Ye, 2014). This broad definition implies that the well-being of the present generation should not be enhanced at the expense of future generations' welfare, and that society's well-being should not deteriorate over time (Stoddart, 2011; UNESCO, 2008).

To put it simply, sustainability is the efficient and equitable distribution of resources intra- and inter-generationally, with the operation of socio-economic activities within the confines of a finite ecosystem (Mensah, 2019). In the literature, sustainability is generally understood to mean integrating social, environmental, and economic issues across the entire supply chain (Ahmad *et al.*, 2017). Consequently, including sustainability concerns in business practices is one of the most dynamic research issues in supply chain management. This outlook on business sustainability is subject to broad interpretation, particularly the clear association of the firm's sustainability identification with the environmental impacts of economic activities. In fact, the substitutive use of the terms “sustainability” and “environmental” was particularly prevalent in early conceptualisations of business sustainability (Gong, *et al.*, 2019; Diabat *et al.*, 2013a; Taghikhah *et al.*, 2019; Ren & Dong, 2018). By adopting sustainable supply chain (SSC) practices, businesses can reduce their negative environmental and social impacts while simultaneously increasing profits and customer loyalty (Wei *et al.*, 2019). In addition to increasing profits and customer loyalty, companies should go beyond and take appropriate actions to safeguard the environment, stakeholders' interests, and their economic viability (Markley & Davis, 2026).

Sustainable supply chain management has become increasingly important for advancing sustainability within organizations. However, limited empirical evidence exists on how the integration of social, environmental, and economic practices within supply chains affects the sustainable performance of manufacturing firms in Ethiopia. In addition, there is no widely established framework for systematically evaluating SSCM effectiveness in the Ethiopian manufacturing context. This study therefore focuses on two central concepts: SSCM practices, represented by the social, environmental, and economic dimensions, and organizational sustainable performance. Although previous studies have examined individual aspects of SSCM, evidence remains limited regarding the combined effect of these dimensions on sustainable performance in Ethiopia's manufacturing sector. The absence of a standardized approach for assessing SSCM performance further reinforces this research gap. Addressing these limitations provides the basis for developing the conceptual framework proposed in this study.

1.2 Overview of the Manufacturing Sector in Ethiopia

This study's sample frame comprises medium- and large-scale manufacturing industries in Ethiopia. Ethiopia is the least developed country, with an agrarian economy in which over 80% of its population lives in rural areas. On top of that, the share of Gross Domestic Product (GDP) from agriculture reduced to 31.8% in 2023/24 from 32.1% in the previous year (NBE, 2024). Consequently, this demands a transformation from a heavy reliance on traditional agriculture to a reliance on commercial agriculture and the manufacturing sector to reduce poverty and achieve sustainable development in the country. To this end, the government has taken several policy measures, specifically through the recent growth and development plan, to foster an industry-led economy (Plan *et al.*, 2019). Therefore, the preference for the industrial sector necessitates promoting and expanding the manufacturing subsector, which is regarded as a primary source of employment and capital accumulation. Table 1 illustrates the manufacturing sector's growth rate and share in the industry over the specified period, highlighting changes in its composition.

Table 1 Growth and Percentage Distribution of the Manufacturing Sector

Year	Growth Rate	Share in Industry
2017/18	5.5	25.3
2018/19	7.7	24.3
2019/20	7.5	23.9
2020/21	5.1	23.4
2021/22	4.8	23.4
2022/23	7	23.4
2023/24	8.4	21.2

According to the National Bank of Ethiopia's Annual Economic Report of NBE (2024) The industrial sector recorded an annual growth rate of 9.2%, contributing approximately 33.1% to total economic growth during the period under review. The manufacturing subsector recorded an 8.4% expansion, contributing approximately 21.2% to the annual growth of the industrial sector and 7% to overall real GDP growth. Simultaneously, the construction industry accounted for 23% of GDP growth and 70.1% of industrial sector growth. Consequently, the construction sector currently stands as the leading sub-sector of the business, driven by the expansion of road, dam, and housing infrastructure.

The service sector is the predominant sector in the Ethiopian economy, achieving an annual growth rate of 7.7% in 2023/24 and accounting for approximately 40.2% of the total economy. During the fiscal year, the predominant contributor to the service sector was wholesale and retail trade, accounting for 14.6% of the entire economy, followed by transport and communications at 5.9%, real estate, renting, and business activities at 4.7%, public administration and defence at 3.9%, financial intermediation at 3.5%, and hotels and restaurants at 2.5% (NBE, 2024).

In 2022/23, according to the National Bank of Ethiopia's Annual Economic Report (NBE, 2023) The industrial sector recorded an annual growth rate of 6.9%, contributing approximately 27.9% to total economic growth during the period under review. The manufacturing subsector recorded 7% growth, contributing approximately 23.4% to the annual growth of the industrial sector and 6.5% to overall real GDP growth. Simultaneously, the construction industry accounted for 20.5% of GDP growth and 73.9% of industrial sector growth. Consequently, the sector presently stands as the foremost sub-sector of the business, driven by the expansion of road, dam, and housing infrastructure.

The service sector was the predominant sector in the Ethiopian economy, achieving an annual growth rate of 7.9% in 2022/23 and accounting for approximately 40.3% of the total economy. During the fiscal year, the predominant contributor to the service sector was wholesale and retail trade, accounting for 14.6% of the entire economy, followed by transport and communications at 5.8%, real estate, renting, and business activities at 4.7%, public administration and defence at 4%, financial intermediation at 3.6%, and hotels and restaurants at 2.5% (NBE, 2023).

In 2021/22, according to the National Bank of Ethiopia's Annual Economic Report *Annual-Report-(2021-22)* the industry sector grew 4.9% in 2021/22, a 2.4 percentage-point decline from the previous year. The industry sector has accounted for 28.9% of total domestic output. In

2021/22, the industrial sector contributed 22.6% to overall economic growth. The manufacturing sector grew by 4.8% in 2021/22, accounting for about 23.4% of industrial output. This has also shown a decline from the previous year.

The services sector was a dominant economic sector in Ethiopia in 2021/22. The services sector accounted for about 40% of the overall economy, contributing 46.7% to GDP growth in 2021/22. Compared with the previous fiscal year, the service sector has expanded by 7.6%. The growth in services sector was largely attributed to the expansion of transport and communication (9.8%), real estate, renting and business activities (9%), hotels and restaurants (8%), wholesale and retail trade (7.9%), public administration and defence (4.5%) and others, including financial intermediation, education, health, etc. Moreover, in 2021/22, the manufacturing sector constituted 59.9% of investment capital, followed by construction (22.1%), real estate, renting and business activities (6%), hotels and restaurants (4.8%), tour operation, transport and communication (2.9%), and others 4.3% (*Annual-Report-2021-22*).

In 2020/21, according to the National Bank of Ethiopia's Annual Economic Report Report (2021) the industrial sector recorded 7.3% annual growth, accounted for 29.3% of total GDP, and contributed 33.6% to overall GDP growth. With 5.1% growth, the manufacturing sector accounted for 23.4% of industrial output. The service sector continued to dominate the economy in 2020/21, accounting for 39.6% of GDP and contributing 38.3% to GDP growth. The 6.3% growth in the service sector was largely attributed to the expansion of real estate, renting and business activities (8.9%), transport and communication (7.0%), wholesale and retail trade (6.3%), other services (6.2%), public administration and defence (4.9%) and hotels and restaurants (2.6%).

In the Distribution of Operational Investment Capital by Sector in 2020/21, the manufacturing sector accounts for 36%. Manufacturing firms are considered vital to economic growth because, by their nature, they create forward and backwards linkages that promote growth. Particularly in economies, these firms are believed to be a potential growth channel for contributing to the country's exports (generating foreign earnings) and employment creation. Medium and large manufacturing enterprises play a crucial role in job creation, innovation, import substitution, ensuring income equality and poverty alleviation (NBE, 2024).

Table 2 below summarises sectoral growth and contribution to GDP in Ethiopia (2020/21–2023/24). The figure illustrates trends in sectoral growth and their contributions to Gross

Domestic Product (GDP) in Ethiopia from 2020/21 to 2023/24, with a particular focus on the industrial and services sectors.

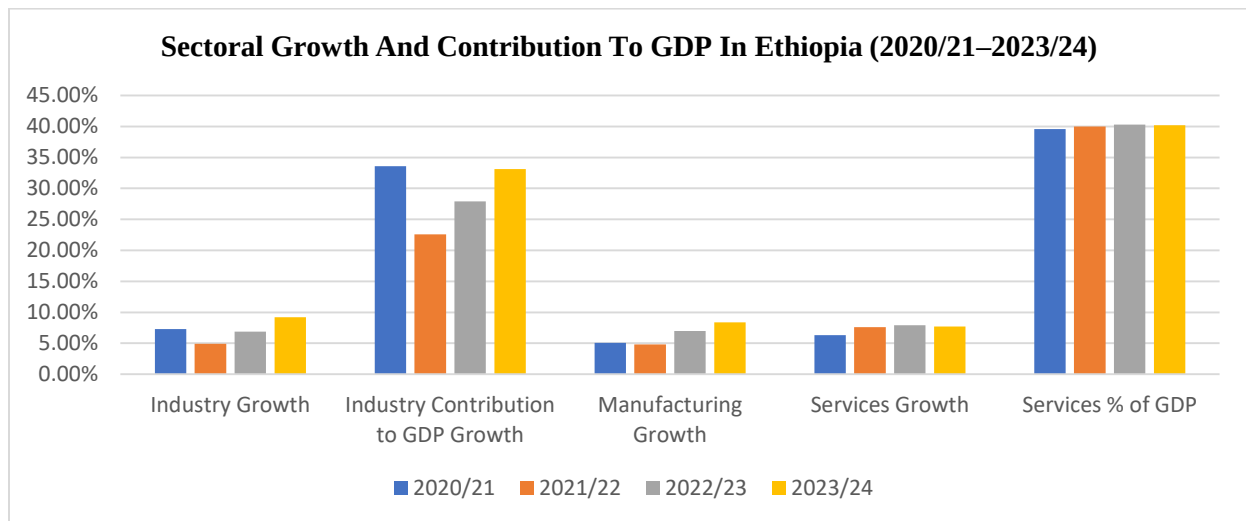


Figure 1 Sectoral growth and contribution to GDP in Ethiopia (2020/21–2023/24)

1.3 Statement of the Problem

Sustainable supply chain management has become increasingly important for improving the environmental, social, and economic performance of manufacturing firms. Despite its growing importance, there is limited empirical evidence on the implementation of SSCM practices across the Triple E dimensions throughout the entire supply chain in the Ethiopian manufacturing industry. In addition, there is no standardized framework for assessing and measuring SSCM performance that is tailored to the Ethiopian context. Existing studies have paid limited attention to integrating the social, environmental, and economic dimensions of sustainability from a supply chain perspective, and the relationship between SSCM practices and firm performance remains insufficiently understood. These gaps justify the need for this study, which seeks to develop a standardized SSCM performance assessment framework and provide empirical evidence on how SSC practices contribute to the sustainable performance of manufacturing firms in Ethiopia.

Supply chain sustainability is a crucial and timely topic, whether inspired by current institutional legislation, public interest, or competitive opportunity. Currently, there is a swiftly growing awareness that supply chains are critical business operations where sustainability practices can

take place and that these SSC practices are highly related to manufacturing and performance (Champion *et al.*, 2014; Blomvall & Hagenbjörk, 2022; Govindan *et al.*, 2020b; Turker & Altuntas, 2014).

Many manufacturing industries create waste and pollution. Consequently, challenges and pressures from regulatory bodies push the manufacturing industry to seriously consider the environmental, empowerment, and economic impacts of its business, specifically across its entire supply chain. Other significant factors have made manufacturing industries more conscious of sustainability, including population growth and the depletion of natural resources. According to Sustainable & Goals, (2017), the world's population grew from 3.7 billion in the 1970s to over 8.3 billion in 2025 and is anticipated to reach 8.6 billion in 2030, 9.8 billion in 2050, and 11.2 billion in 2100. As a result, resource availability decreases, leading companies to realise that their supply chains must be redesigned to sustain their existence and competitiveness (Zailani *et al.*, 2012; Carter *et al.*, 2020; Carter & Rogers, 2008b; Tornese *et al.*, 2018). Prasad *et al.* (2020) contends that institutional pressures, particularly from government, markets, customers, stakeholders, and society, compel organisations to adopt SSC practices, predicated on the expectation that these sustainability initiatives correlate positively with organisational performance.

Sustainability issues are amongst the most prominent business concerns in a firm's supply chain, and supply chain management is also a promising area for achieving sustainability (Ahmad *et al.*, 2017; Morali & Searcy, 2013; Mitra & Datta, 2014). An increasing number of firms have reassessed their supply chains and moved forward in their effort to build a more SSC by not only monitoring their suppliers' compliance but also by promoting their capabilities to address various environmental and social challenges (Yildiz Çankaya & Sezen, 2019; Yildiz Çankaya & Sezen, 2019). The triple E model describes integrating economic, social, and environmental criteria into performance objectives for managing the entire supply chain. Therefore, the management of economic, environmental, and social issues in the supply chain, namely SSC management, has become a critical issue (Gong *et al.*, 2019).

Nowadays, supply chain sustainability extends beyond integrating environmental, social, and economic factors in sourcing, production, and delivery to encompass strategies for reuse, recycling, and end-of-life management. As a result, manufacturing companies in developed

countries are reaping the benefits of SSC for environmental protection. Having been recognised for it, they enter the global markets, increase customer loyalty, reduce waste, attract and retain qualified employees who have a strong commitment towards sustainability, unlike manufacturing companies in developing countries in general and in Ethiopia in particular (Bag, 2014; Bag *et al.*, 2015; Stranieri *et al.*, 2019; Gong, *et al.*, 2019).

Hart and Dowell (2011) also indicated that a SSC strategy that involves all Triple E aspects will lead to sustained and improved competitive advantage and higher firm performance in developed and emerging economies. According to Haleem *et al.*, (2022), and the World Economic Forum, (2020), 60% of today's customers are willing to change their shopping behaviours to reduce the negative impact on the environment, and 70% of workers would prefer to work at a company with a strong environmental sustainability program. So, sustainability is becoming a critical factor in employees' decisions to choose and stay with a given business organisation. Investors also paid close attention to sustainability and prioritised it in their investment decisions. Similarly, sustainability and profitability can align, as previous surveys and reports, such as Haleem *et al.*, (2022) and the World Economic Forum, (2020), indicate that sustainable practices can enhance profitability. For example, corporations that strategically plan for climate change can achieve an 18% higher Return on Investment (ROI) than those that do not. Though the current understanding of the drivers that encourage the implementation of SSC management practices is still limited in developing countries in general and in Ethiopia in particular (Chavez *et al.*, cited in Fernández, 2015).

A company must ensure that its SSC practices, which integrate the Triple E's or SSC management, contribute positively to its overall firm performance (Govindan *et al.*, 2020b; Mathivathanan *et al.*, 2018). The competitive strategy will be derived, either explicitly or implicitly, from the efficient alignment of SSC integration and performance. Supply Chain Management has been one of the most productive research fields in management sciences and business development for a long time. Empirically, however, sustainability in supply chain management, in accordance with the Triple E dimensions and across the whole supply chain, is less well addressed in developing nations like Ethiopia (Balda, 2020; Jia, Zuluaga-Cardona, *et al.*, 2018; Balda *et al.*, 2019; Sancha Fernández & Thomsen; 2015; Sánchez-Flores *et al.*, 2020).

Research indicates that it remains unclear whether manufacturing firms that more extensively adopt SSCM achieve superior performance specially in emerging economies (Zailani *et al.*, 2012). According to Movahedipour *et al.* (2017), Balda *et al.*, (2019), and Jia, Zuluaga-Cardona, *et al.*, (2018), the lack of a clear link between SSCM practices and performance improvements is a hindrance for manufacturing firms in developing countries seeking to define SSCM implementation.

Consequently, significant research is required to explore the existing practices of SSCM (with due emphasis on Triple E performance) throughout the Ethiopian manufacturing industry's supply chains. This research has examined the influencing factors, driving forces, and the resulting impact on both individual firms and overall industry performance. To the researcher's best knowledge, there is insufficient empirical evidence examining sustainability practices across the entire supply chain and within all manufacturing subgroups in the Ethiopian manufacturing industry.

1.4 Research Gap

In the past decade, it has been observed that the development of sustainability issues is one of the most prominent business concerns in a firm's supply chain, and SCM is also believed to be a promising area through which to achieve sustainability (Ahmadi *et al.*, 2017; Morali and Searcy 2013, Mitra and Datta 2014). An increasing number of firms have reassessed their supply chains and moved forward in their effort to build a more sustainable supply chain, by not only monitoring their suppliers' compliance but also by promoting their capabilities to suitably address various environmental and social challenges (Ahmadin *et al.*, 2017). The triple E indicates that the combination of economic, social, and environmental criteria must be integrated into performance objectives for the management of the entire supply chain. Therefore, the management of economic, environmental, and social issues in the supply chain, namely sustainable supply chain management, has become a critical issue (Gong *et al.*, 2019).

Pagell and Wu (2009) argued that SSCM comprises managerial decisions and behaviours designed to ensure that a supply chain performs well in the TBL (Triple E) dimensions to create a truly sustainable supply chain. Therefore, these managerial decisions and behaviours should be intended to ensure that firms in their supply chain as a whole perform well economically,

environmentally and socially. This can be achieved through the strategic integration of key business processes, such as resource management, resource conversion, and/or product and service delivery (Pagell & Wu, 2009).

A company must ensure that its sustainable supply chain practices, which include integration of all Triple E's or SSCM, support its overall firm performance (Kannan *et al.*, 2013). The competitive strategy will be derived, either explicitly or implicitly, from the efficient alignment of sustainable supply chain integration and performance. SCM is one of the most productive research fields in management sciences and business development for a long time (A. M. Walker *et al.*, 2021). Empirically, however, sustainability in supply chain management, in accordance with the Triple E dimensions and across the whole supply chain, is less well addressed in developing nations like Ethiopia (Balda, 2020; Jia *et al.*, 2018b; Balda *et al.*, 2019; Sancha Fernández and Thomsen, 2015).

Supply chain management sustainability is being viewed as a context of three large areas interacting with each other to address humanity-centric problems. This aspect, as a framework, is widely known as the Triple-E model, also called the Triple Bottom Line, which comprises three main areas: Economics, Environment, and Empowerment. Related studies have achieved this integration in the Supply Chain; however, there is a gap in integrating TBL into a single analytical framework and in assessing it. Consequently, many studies have investigated the integration only between two sustainability dimensions, that is, social and environmental sustainability (Ortas *et al.*, 2014a; Kumar *et al.*, 2023; & Bashar *et al.*, 2023). Furthermore, the argument on whether economic benefits can be attained through the successful implementation of social and environmental sustainability is still an ongoing discussion in the field of supply chain management (Sudusinghe & Seuring, 2020a; Raza *et al.*, 2021; Sachin & Rajesh, 2022;; Govindan *et al.*, 2020b). This is why various scholars, such as Winter & Knemeyer, (2012), have called for a holistic perspective on sustainability to understand the economic consequences of these practices. The work of Eltayeb, (2009)also vividly showed that socially and environmentally rigorous practices across the supply chain bring strategic economic benefits. The amalgamation of social and economic sustainability dimensions in TBL is critical, predominantly due to the following reasons:

- Firstly, an inadequate number of studies have focused on this amalgamation, especially from a supply chain perspective.

- Secondly, it is an open question of how a socially, environmentally, and economically sustainable supply chain affects the economic performance of a firm.

From a scholarly perspective, the causal relationship in this interrelation has been a recurring debate. This argument originates from doubt whether the economic performance of a company is a direct result of embracing sustainable practices or the companies that are performing well adopt these practices (Sudusinghe & Seuring, 2020b, 2018; Jia *et al.*, 2018a; Gong *et al.*, 2019; Elkington, 2001; Winter and Knemeyer, 2012; Ortas *et al.*, 2014b; Eltayeb, 2009).

Besides the above argument, reviewing various findings of previous researchers shows that it remains unclear if manufacturing firms that more expansively adopt SSCM perform well (Zailani *et al.*, 2012). According to Movahedipour *et al.* (2017), Balda *et al.* (2019) and Jia *et al.* (2018b) The absence of a clear connection between SSCM practices and performance enhancements is a hindrance for manufacturing firms in developing countries seeking to justify Sustainable supply chain management implementation.

Thus, much research is needed to investigate the current practice of sustainable supply chain management (with due emphasis in the Triple E performance) in the whole supply chain system in Ethiopian manufacturing industry, to determine the factors affecting the practice, to investigate the driving forces for its practice and the impact of this practices on individual firm's performance and in the industry's performance in general.

To the best of the researcher's knowledge, there are no sufficient empirical findings in the Ethiopian manufacturing industry that investigate sustainability practices across the entire supply chain and within all manufacturing subgroups.

Therefore, this research focuses on assessing the role of socially, environmentally, and economically sustainable supply chain practices in enhancing firm performance in large manufacturing industries in Ethiopia. Manufacturing firms are considered vital to economic growth because, by their nature, they create forward and backwards linkages that promote growth. Particularly in economies, these firms are believed to be a potential growth channel for contributing to the country's exports (generating foreign earnings) and employment creation. Medium- and large-scale manufacturing enterprises play a crucial role in job creation, innovation, import substitution, and in ensuring income equality and poverty alleviation. In the Ethiopian case, the industrial sector recorded 7.3% annual growth, accounted for 29.3% of total GDP, and contributed 33.6% to overall GDP growth. With 5.1% growth, manufacturing

accounted for 23.4% of the industrial output. According to the National Bank of Ethiopia's Annual Economic Report for 2020/2, in the distribution of operational investment capital by sector in 2020/21, the manufacturing sector accounts for 36%. Looking at the Ethiopian Central Statistical Agency (ECSA) data regarding the manufacturing sector, 3627 medium and large manufacturing industries are actively involved in the economy (Ababa, 2018).

1.4.1 Summary of the key research gaps identified

1. Absence of a standardised framework for assessing sustainable supply chain management (SSCM) performance in Ethiopian manufacturing industries.
2. Challenges in developing measurement tools tailored to the Ethiopian context for evaluating sustainability performance.
3. Limited studies on integrating social, environmental, and economic sustainability dimensions within the Triple Bottom Line framework, especially from a supply chain perspective.
4. Establishing a clear causal relationship between adopting sustainable practices and economic performance, and uncertainty regarding the connection between SSCM practices and performance enhancements in Ethiopian manufacturing firms.
5. Lack of empirical research on sustainability within Ethiopian manufacturing supply chains, highlighting the need for comprehensive studies.

1.5 Research Aim and Objectives

This research analyses the impact of social, environmental, and economically sustainable practices on the performance of major manufacturing industries in Ethiopia. Using the Triple 'E' dimension, which examines economic, environmental, and social sustainability, the study develops a conceptual framework for performance measurement. Additionally, it investigates the pressures exerted on firms by supply chain actors within the studied context.

Thus, this research aimed to develop a standardised framework for assessing and measuring sustainable supply chain management performance and to examine the role of socially, environmentally, and economically sustainable supply chain practices in enhancing firm performance across the large and medium-sized manufacturing industries in Ethiopia.

To achieve the above aim, the following objectives are set out;

1. To investigate the practice of the SSC management in the manufacturing industry internationally and in Ethiopia, and identify key indicators and metrics related to social,

environmental, and economic sustainability in the context of manufacturing industries in Ethiopia through a literature review and survey.

2. To identify factors (enablers and barriers) affecting sustainable supply chain practice/implementation in the Ethiopian manufacturing industry.
3. To investigate the determinants of SSC practices on a firm's performance.
4. To develop a guiding measurement framework to enable the manufacturing industry to adopt the SSC practice successfully.
5. To verify/ validate the developed performance measurement framework/model.

1.6 Novelties and Contributions of the Study

1.6.1 Theoretical Contribution

The study has developed a framework for assessing and measuring sustainable supply chain management performance. The framework has measured sustainable SSCM performance, accounting for key concepts and variables. The measurement framework will identify sustainability indicators and define measurement and performance evaluation. Moreover, the framework will outline the operational, tactical, and strategic perspectives of sustainable supply chain management. The measurement framework will underpin a strategic model for successfully adopting SSC strategies in the manufacturing sector in Ethiopia.

The study has also investigated and measured the current sustainable supply chain performance of the Ethiopian large- and medium-scale manufacturing industry, enabling the identification of drivers and barriers to effective SSCM implementation in Ethiopia. Furthermore, the study's theoretical contributions are summarized below.

- **Contextualizing the Triple E Concept in Developing Countries:** The study provides empirical evidence on the applicability of the Triple E concept (encompassing economic, environmental, and social sustainability), within the Ethiopian manufacturing context. Although the concept has been widely applied in developed economies, its application in developing countries may be shaped by different socio-economic and institutional conditions. The findings suggest that manufacturing firms in Ethiopia need to give attention to the three dimensions of sustainability rather than focusing primarily on short-term financial outcomes. In this regard, the study extends the empirical application of the Triple E concept to the context of a Sub-Saharan developing country.

- **Differences in Sustainability Adoption between Export-Oriented and Domestic-Oriented Firms:** The findings indicate considerable differences in the adoption of sustainable supply chain practices between export-oriented and domestic-oriented manufacturing firms. Export-oriented firms are more exposed to international customer requirements and regulatory expectations, which create stronger incentives for the adoption of sustainable practices. In contrast, domestic-oriented firms experience relatively limited pressure from local institutions and customers. The study found that government regulatory pressure on local manufacturers is limited, while awareness of sustainability among local customers is also relatively low. As a result, domestic firms have fewer external incentives to prioritize sustainable supply chain practices. These findings provide further insight into how market orientation and external pressures influence sustainability adoption in developing-country manufacturing.
- **Relationship between Sustainability Practices and Firm Financial Performance:** Using Ordinary Least Squares (OLS) and logit models, the study examines the relationship between institutionalized sustainability practices, including environmental policies, EMS certification, and CSR practices, and firm financial performance as measured by gross profit. The findings show positive and statistically significant relationships between these sustainability-related practices and financial performance. This provides empirical support for the relevance of sustainability practices to firm performance in the Ethiopian manufacturing context, where firms may face financial and resource constraints. However, the findings should be interpreted as evidence of statistical association rather than direct causation.
- **Institutional and Stakeholder Perspectives across Different Market Orientations:** The findings also provide further insight into institutional and stakeholder perspectives by showing that external pressures do not affect manufacturing firms uniformly. Export-oriented firms, which are more exposed to international customers and regulatory requirements, experience stronger pressures to adopt sustainable supply chain practices. Domestic-oriented firms, in comparison, operate under relatively weaker regulatory and market pressures and demonstrate lower levels of sustainability adoption. The comparison between the two groups indicates that regulatory enforcement, customer expectations, and exposure to international markets are important factors in explaining differences in sustainable supply chain adoption within the same national manufacturing context. This finding highlights the importance of

considering market orientation when examining the influence of institutional and stakeholder pressures on sustainable supply chain practices.

1.6.2 Practical Contributions

In this research, the current supply chain sustainability performance of the Ethiopian medium- and large-scale manufacturing industry has been investigated and quantified. This has enabled the identification of drivers and barriers to effective SSCM implementation. Another prominent contribution of this study is the development of a single, all-encompassing framework that incorporates key performance indicators for all Triple E sustainability dimensions. It is expected that the framework will add empirical knowledge to the literature on SSCM.

1.6.2.1 Contribution to the Ethiopian large and medium manufacturing industries

As clearly indicated in the section addressing research gaps, assessing and implementing supply chain sustainability practices, as well as measuring them, poses a significant challenge for large and medium manufacturing industries in Ethiopia. This process necessitates identifying the relevant supply chain sustainability practices and key performance indicators, along with suitable measures for each of the three pillars of sustainability: environmental, economic, and social. Furthermore, it requires a comprehensive understanding of how these supply chain sustainability practices influence overall firm performance.

The primary contribution of this research to the Ethiopian large and medium manufacturing sectors is of great importance. This study will assist manufacturing industries by identifying and presenting supply chain sustainability practices that are relevant to the Ethiopian context through an extensive literature review, surveys, interviews, and focus group discussions. As a result, the manufacturing sector in Ethiopia will find it easy to adopt and implement these practices.

Secondly, as a contribution, the research highlights a noteworthy positive relationship between the implementation of sustainable supply chain practices and firm performance, based on analyses of studies and reports from global manufacturing sectors, as well as practical examples. As a result, this can improve understanding within manufacturing industries of the significance of adopting sustainable supply chain practices for a company's performance, encouraging Ethiopian manufacturing firms to embrace them voluntarily.

The research also aimed to examine and evaluate the legal context surrounding the enforcement and oversight of sustainability practices in supply chains at both national and international levels,

enabling Ethiopian manufacturing industries to understand and take the necessary steps to adopt sustainability practices to comply with legal obligations and succeed in their respective markets. The study successfully pinpointed the key obstacles and facilitators of sustainable supply chain practices for Ethiopian manufacturing industries, enabling these industries to develop effective strategies and actions to leverage the facilitators and address challenges they may encounter when implementing sustainability in their supply chain operations.

As is well known in the field of decision-making and management, decision makers and managers cannot manage what they cannot measure. To address this, the research provides SSC practices and measures suitable to the Ethiopian industry context. To be more specific, this study presents numerical and non-numerical performance measures in the form of Key Performance Indicators (KPIs) for each of the supply chain sustainability pillars (environmental, economic, and empowerment). Hence, the Ethiopian manufacturing industries will benefit from this study by straightforwardly recognising and implementing sustainable supply chain practices with appropriate measures.

As an academic contribution, it is a valuable addition to the limited body of literature on sustainability supply chain management in Africa, particularly in Ethiopia. Moreover, as part of the policy and sectoral reform, this study provides policy implications for national and local policymakers. It paves the way for reforming the supply chain and logistics management in Ethiopia.

1.6.2.2 Practical & Managerial Contributions

- **A Standardized Tool for Performance Benchmarking:** One of the main practical contributions of this study is the development of a conceptual framework that can be applied by medium and large manufacturing firms in Ethiopia to assess and monitor sustainable supply chain performance. The framework provides managers with a structured basis for identifying areas of strength and weakness, evaluating the extent to which sustainability practices have been implemented and monitoring changes in performance over time. It can therefore support firms in systematically integrating sustainability considerations into their supply chain management practices.
- **A Strategic Direction for Domestic Firms:** The findings indicate that firms primarily serving the domestic market tend to demonstrate lower levels of sustainable supply chain implementation than export-oriented firms, partly reflecting differences in institutional

and external market pressures. This finding provides an important consideration for managers of domestic manufacturing firms. Rather than viewing environmental management systems (EMS) and corporate social responsibility (CSR) practices solely as compliance requirements, firms can consider them as part of their broader operational and strategic improvement efforts. The study also provides evidence of a positive association between the adoption of certain sustainability-related practices, including EMS and CSR, and firm performance. This suggests that sustainability initiatives may contribute to improved business outcomes when they are appropriately integrated into organizational strategies.

- **Targeted Approaches to Addressing Implementation Barriers:** The study identifies high implementation costs and inadequate knowledge and training as important barriers to the adoption of sustainable supply chain practices among Ethiopian manufacturing firms. These findings have direct implications for operations managers, human resource managers, and other organizational decision-makers. In particular, they suggest the need for targeted employee training and capacity-building initiatives, together with appropriate financial and budgetary planning for sustainability-related activities. Addressing these barriers systematically may enable firms to move beyond isolated sustainability initiatives and develop more consistent and integrated practices.
- **Policy Implications for Industrial Park and Manufacturing Governance:** The findings also provide relevant insights for policymakers, government institutions, and industrial park authorities. The observed differences in sustainability practices and the influence of institutional pressures suggest that existing regulatory and institutional mechanisms may not provide sufficient incentives for all firms, particularly those focused on domestic markets, to adopt sustainable practices. Strengthening stringent regulatory enforcement, improving institutional support, and providing accessible sustainability-related training and capacity-building programs could therefore help manufacturing firms improve their environmental and social performance. Such measures may also support Ethiopian manufacturers in meeting the sustainability requirements increasingly associated with participation in international markets.

1.6.2.3 Contributions to Training Providers

- **Identification of Training Needs:** The study identifies lack of knowledge and training, together with the high cost of implementation, as important barriers to the adoption of sustainable supply chain practices in Ethiopian manufacturing firms. These findings provide training institutions and professional development providers with evidence of specific areas in which capacity-building interventions are needed. Rather than relying primarily on general sustainability courses, training providers could develop practical programs that address the application of sustainable practices within manufacturing operations, including approaches for implementing sustainability at relatively low cost and assessing the potential organizational benefits of such initiatives.
- **Application of the Developed Framework in Training:** The framework developed in this study may also be adapted by training providers as a practical learning and assessment instrument. It can provide a structured basis for developing training materials for operations managers, supply chain professionals, auditors, and other personnel responsible for implementing and monitoring sustainability practices. In this respect, the framework can help connect theoretical knowledge with the practical assessment of sustainable supply chain performance within manufacturing organizations.
- **Support for Certification and Specialized Training:** The findings concerning environmental management systems provide further implications for professional training and certification providers. The study found an association between EMS certification and firm performance, including gross profit. While this finding should not be interpreted as evidence of a direct causal relationship, it indicates that EMS-related capabilities may be relevant to organizational performance. Training providers can therefore consider strengthening programs related to environmental management systems, including ISO 14001, alongside training in CSR and sustainable supply chain management.
- **A Potential Training Market among Domestic Manufacturers:** The study also indicates differences in sustainability practices between firms serving domestic markets and those engaged in export markets. This suggests a potential need for targeted capacity-building among domestic manufacturers, particularly firms that may face increasing sustainability requirements as they seek to participate in regional and

international markets. Training providers could respond by developing introductory and intermediate programs tailored to the specific circumstances of domestic manufacturers. Such programs could focus on building basic sustainability capabilities, identifying feasible improvement measures, and preparing firms to respond to evolving environmental, social, and market requirements.

1.6.2.4 Contributions to Export-Oriented Manufacturing Firms

- **Relationship between Sustainability Practices and Firm Performance:** The study found a statistically significant association between the adoption of formal environmental policies, environmental management system (EMS) certification, corporate social responsibility (CSR) practices, and gross profit. This finding suggests that sustainability practices may have implications for the financial performance of export-oriented firms. It also provides a basis for firms to consider sustainability investments not only from a compliance perspective but also in relation to their potential contribution to business performance.
- **A Benchmarking Tool for International Compliance:** The standardized measurement framework developed in this study can be used by export-oriented firms as a diagnostic tool to assess their sustainable supply chain practices. It can help firms identify areas of weakness and monitor their performance against relevant sustainability requirements. Such assessment may also assist exporters in responding to the environmental and social standards increasingly required by international buyers and regulatory bodies.
- **Demonstrates How to Leverage External Pressures for Advantage:** The findings indicate that external pressures, particularly international customer expectations and regulatory requirements, play an important role in encouraging firms to adopt sustainable supply chain practices. Export-oriented firms can therefore use these pressures as an incentive to improve their sustainability performance rather than considering them only as compliance requirements. Improving environmental and social practices may help firms strengthen their relationships with international customers and improve their position within global supply chains.

- **Upstream Supply Chain Risks:** The study also highlights weaknesses in the local supply base, particularly the relatively low level of sustainability adoption among domestic suppliers. This situation may create sustainability-related risks for export-oriented firms that depend on local suppliers. The findings therefore suggest the need for exporters to pay greater attention to supplier assessment and development, including, where relevant, suppliers beyond their immediate tier. Supporting local suppliers in improving their sustainability practices may contribute to reducing supply chain risks and improving the overall sustainability performance of export-oriented firms.

1.7 Scope of the Study

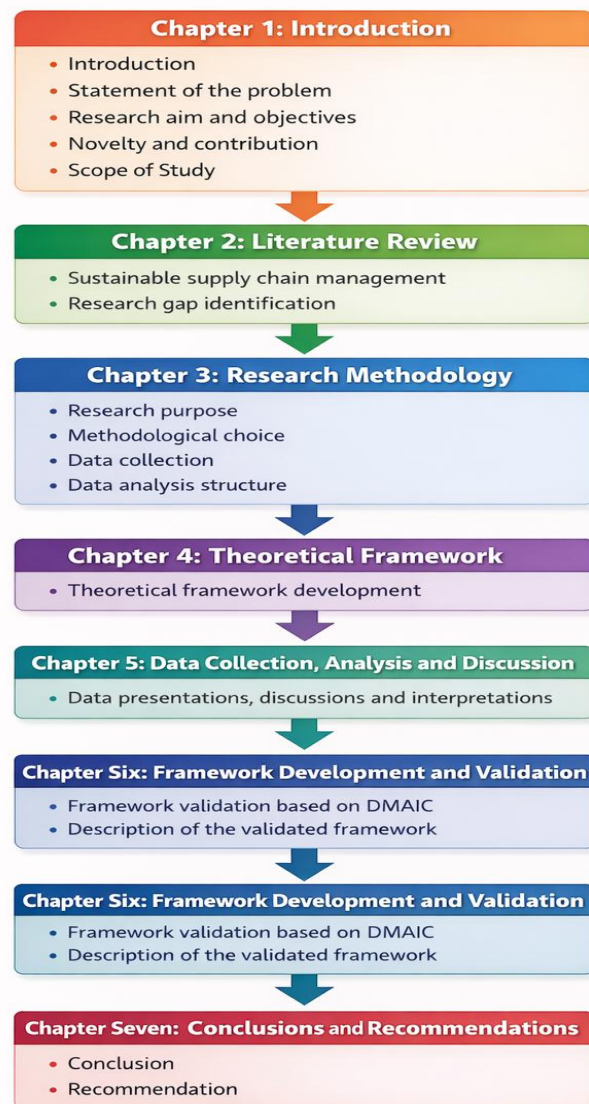
This study focuses exclusively on examining the integration of the Triple 'E' dimensions into the supply chain system and their influence on firm sustainability performance. The research explores the performance ramifications of SSCM practices within the Economic, Empowerment, and Environmental dimensions. The study concentrated solely on large and medium manufacturing industries, including Industrial Parks. The selection of large and medium-sized manufacturing industries was based on their demonstrated awareness and capacity to adopt SSCM practices compared to small manufacturing enterprises. Additionally, these industries experience higher pressure from supply chain actors to implement SSCM practices. Geographically, the study encompassed large and medium manufacturing industries and industry parks situated in Addis Ababa, Kilinto, Adama, and Hawassa.

1.8 Structure of the Research

This section provides an overview of the study's structure. The study comprises seven chapters. The first chapter introduces the study. The introduction chapter covers the study's background, the statement of the problem, the research aims and objectives, the research's novelty and contribution, and the scope of the study. Chapter two provides a literature review. In this chapter, the most important literature on sustainable supply chain management has been reviewed, and the research gap has been identified. Chapter three presents a summary of the research techniques, methodological choices, research purpose, philosophy, and approach used in this study. Chapter four presents data collection and analysis. In the fifth chapter, data interpretation and discussion are explained in detail. In chapter six, the validated framework is presented in

detail. In the last chapter (chapter seven), the research's conclusions and recommendations are presented. The major empirical findings and analyses are summarised in this chapter.

Figure 2 Structure of the chapters



CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter aims to review the key literature on sustainable supply chain management and identify gaps for further investigation. The recent, most notable literature on SSCM is reviewed using exploratory and meta-synthesis approaches. The exploratory approach employed in this study uses peer-reviewed articles to support the study. An exploratory literature review creates an opportunity to further fill the gap in the body of knowledge. Exploratory literature reviews are based on different bodies of literature and draw on theories. The exploratory literature review requires pre-existing knowledge of the topic under investigation. On the other hand, the Meta-synthesis approach focuses on non-statistical procedures for analysing the findings of qualitative studies and involves broad conceptualisations and interpretations.

The literature review adopted a screening methodology using a keyword that includes ‘Sustainable supply chain’, ‘stakeholders’, ‘resources’, ‘drivers’, ‘Triple E’, ‘sustainable practices’, and ‘environmental practices’. The study used relevant databases, including Science Direct, Web of Science, Scopus, and Emerald, to identify pertinent literature. Despite the researcher’s interest in using only recent articles, the lack of mature studies in Ethiopia has forced the researcher to include all relevant articles, regardless of time frame and focus on sustainability in SCM. For the review, the study focuses on the title, keywords, abstract, findings, and conclusion of each article.

This chapter comprises four main sections. The first section discusses the theoretical framework, providing a detailed explanation of the conceptualisation of SSCM, the resource-based view, stakeholder theory, institutional theory, and transaction cost economics (TCE). The second section presents an empirical review, which is assessed in line with the drivers of SSC, SSCM, and firm performance.

2.2 Conceptual Frameworks

This section discusses the prime and dominant theories that reinforce SSCM. These theories have the potential to enlighten various elements of SSCM more than any other theories. The theories delineate the dominant theoretical frameworks utilised in this study. This section deals with the functions of these prevailing theories and their integration. As a prevailing theoretical framework in the discipline, the review also formulates research propositions to deepen understanding of

these theoretical views. The main theories related to sustainable supply chains include the Resource-Based View (RBV), Stakeholder Theory, Institutional Theory, and Transaction Cost Economics. These theories have been utilised to outline the driving factors and barriers (obstacles) associated with SSCM, to illustrate the complexities of managing sustainability challenges within organisations, to pinpoint key performance indicators for SSCM, and to clarify the benefits and challenges SSCM presents to businesses.

2.2.1 Conceptualisation of Sustainable Supply Chain Management

The term sustainability integrates environmental, economic, and empowerment responsibilities into a firm's operations (Wang & Dai, 2018a). Govindan et al., (2020b) defines SSCM as the set of practices that improve an overall firm's performance during development, production, procurement, and distribution of a product or service to current and potential customers along the supply chain. Oktem (2014) further decomposed the term sustainability into consideration for profit, people, and the planet, and incorporated this into the firm's culture, strategy, and operations within the perspective of the triple bottom line approach. The triple bottom line approach includes environmental, social, and economic perspectives to achieve supply chain sustainability. Nogueira *et al.* (2022) contends that the triple bottom line is central to the economic development of nations, and that concerns about improving social, environmental, and economic living standards form the basis of the triple bottom line (TBL).

Ortas *et al.* (2014a) define SSCM as skills and leverage that capacitate firms to structure their business processes to achieve sustainable performance. A sustainable supply chain integrates environmental, economic and social issues into supply chain management to improve the firm's linkage and bonding with its suppliers and customers without compromising its economic performance. According to Seuring *et al.* (2008), sustainable supply chain management is the management of material and information flows, as well as cooperation among companies along the supply chain, to improve sustainable development, i.e., economic, environmental, and social empowerment. The unprecedented growth of globalisation and continued outsourcing across industries has prompted firms and organisations to operate and compete on a supply chain basis. At the same time, vigorous supply chain activities have made organisations responsible for the environmental and social performance of their suppliers and partners. These pressures are derived from several internal and external factors, including employees and management, social

responsibility, communities, governments and nongovernmental organisations (Seuring *et al.*, 2008).

Developing nations observed a low level of sustainable supply chain management, as they face relatively more barriers to sustainability in comparison to developed nations (Baig *et al.*, 2020). The developing nations' status as latecomers to global trade has affected their sustainability practices; however, there has been a growing effort toward sustainability in response to the global climate change crisis, which has forced firms to adopt green supply chain management. Green supply chain management has emerged as an important organisational philosophy to achieve an organisation's profit and market share objectives by reducing environmental risks and impacts while improving the ecological efficiency of these organisations and their partners (Diabat *et al.*, 2013b). According to Wang & Dai, (2018a), in the manufacturing industry, sustainability refers to creating a sustainable community that can influence and support firms in their sustainable supply chains, thereby improving the integration of SSCM practices into traditional supply chains. Barriers directly impacting should be mitigated, among which sectoral and economic factors are the most crucial.

Table 2 presents essential insights and findings from diverse academic and industrial research on Sustainable Supply Chain Management (SSCM). This document encapsulates the author, methodologies, year and key findings, emphasising the various ways researchers and organisations have tackled sustainable practices, problems, and performance implications throughout supply chains.

Table 2 Key findings from relevant studies on sustainable supply chain management ordered in reverse chronological order from newest to oldest

No	Author	Method	Year	Key Finding
1.	(Nogueira <i>et al.</i> , 2022)	Survey	2022	The social dimension of TBL promotes economic development, while the environmental dimension limits it. The economic dimension contains conflicting synergies in economic development.
2.	(Emamisaleh & Taimouri, 2021)	Survey	2021	Employees' motivation and managerial attitude have positive impacts on strategic sustainability orientation.
3.	(Pandey <i>et al.</i> , 2021)	Survey	2021	Senior management support, followed by government support and the environmental team, are the most critical success factors for sustainable supply chain management
4.	(Baig <i>et al.</i> , 2020b)	Survey	2020	Sectoral, economic, managerial, and supplier-related barriers directly impact the adoption of SSCM practices, either positively or negatively.
5.	(Govindan <i>et al.</i> , 2020a)	A psychometric meta-analysis	2020	There is a positive association between sustainability and firm performance, and a stronger relationship in manufacturing industries than in service industries.
6.	(Saeed & Kersten, 2019)	Literature Review	2019	Regulatory and market pressures are the most dominant drivers of SSCM practice
7.	(Narayanan <i>et al.</i> , 2019)	Survey	2019	Lack of benchmarking and government initiatives are the major challenges in implementing sustainable practices.
8.	(Nayak & Dhaigude, 2019)	Survey	2019	Financial constraints, top management support, competition, culture, infrastructure, and planning and execution are independent driving factors. In contrast, people, customer acceptance, government support, supplier acceptance, and external stakeholders are dependent driving factors.
9.	(Wang & Dai, 2018a)	Survey	2018	Firm's internal sustainable supply chain management practices have a positive impact on the firm's environmental and social performance
10.	(Saeed <i>et al.</i> , 2017)	Literature Review	2017	External drivers of sustainable supply chains are more important than internal drivers for implementing sustainability practices.
11.	(Rajeev <i>et al.</i> , 2017)	Literature review	2017	The results show that studies in developed economies were far more mature than those from emerging markets. Moreover, the study of SSCM has increased since 2011 due to growing concern for the environment.
12.	(Alzawawi, 2014)	Survey	2014	Financial benefits are the greatest influence in the adoption of sustainable practices into supply chain systems, followed by government regulations.
13.	(Bag <i>et al.</i> , 2019.)	Survey	2014	Sustainable supply chain practices are mainly influenced by market pressure,

				market Share, and Profit.
14.	(Oktem, 2014)	Survey	2014	Individuals' decisions on environmental issues shape firms' agendas on the issue.
15.	(Ortas <i>et al.</i> , 2014a)	Survey	2014	Sustainable supply chain performance and companies' margins and revenue are bidirectional, and firms' profitability and sustainable supply chain performance are unidirectional.
16.	(Schrettle, Hinz, Scherrer-Rathje, <i>et al.</i> , 2014)	Literature Review	2014	Knowledge capacities must be aligned with the changing market requirements and market dynamics.
17.	(Diabat <i>et al.</i> , 2013b)	Survey	2013	Design for the environment, customer collaboration, and reverse logistics are the top three SSCM practices and can improve SSCM performance.
18.	(Hsu <i>et al.</i> , 2013)	Survey	2013	Regulatory measures, competitor pressures, customer pressures and socio-cultural responsibility are the main supply chain drivers.
19.	(Morali & Searcy, 2013)	Survey	2013	Stakeholder pressures are the major drivers of sustainability initiatives. Moreover, firms focus on economic and environmental dimensions of sustainability.
20.	(Gavronski <i>et al.</i> , 2011)	Survey	2011	Managers are seeking to implement green supply chain management because they believe internal investment in green process management is a step toward environmental management of their external supply chains.
21.	(Seuring <i>et al.</i> , 2008)	Literature Review	2008	Environmental and social standards play a crucial role in economic supplier evaluation.

2.2.2. Resource-Based View

As the origin of the Resource-Based View (RBV), Kor & Mahoney (2000), theorised that the growth of a firm is rooted in its unique internal resources, which distinguish it from other firms and enable superior performance (Barney *et al.*, 2001a). In their review of Wernerfelt (1984), who was also a pioneer in introducing RBV, they further elaborate that a firm's resources and products are two sides of the same coin. Barney *et al.* (2001a) indicates that most firms' output in the form of a product requires the services of several resources. It is possible to deduce the minimum required resource commitments by describing the firm's engagement across various products; conversely, it is possible to identify the best product-market activities by defining a firm's resource profile.

Barney *et al.* (2001b) employs the resource-based view (RBV) to identify shortcomings in environmental models of competitive advantage. It also seeks to establish a connection between the heterogeneous resources under an organisation's control. It connects the mobility of these resources within the industry and the strategic or competitive advantage attained by the organisation.

A firm's resources enable it to establish strategies that improve the organisation's overall efficiency and performance. Barney classifies resources in three broad categories: physical capital, human capital, and organisational capital.

- Physical capital means resources like plant and equipment, technology, location, and access to raw materials.
- Human capital resources include the training, experience, and insight from managers and employees.
- Organisation capital resources include the organisational structure, planning, and internal operational systems.

Barney *et al.* (2001b) indicate that resources can be examined in terms of heterogeneity (uniqueness) and immobility (possession by other competing firms). The authors further argue that firms cannot gain a competitive advantage when institutional strategic resources are uniformly distributed across competing firms and are transferable.

Kor and Mahoney (2000) recap fundamental elements of the theory of the growth of the firms in 10 basic ideas as follows:

- Firm's growth can be usefully studied as a dynamic process of management interacting with resources.
- Firms are institutions created by people to serve the purposes of people.
- Services of resources are drivers of firm heterogeneity.
- Services that material resources will yield depend upon the knowledge possessed.
- The firm's growth is a function of firm-specific experiences in teams.
- Managerial capability is the binding constraint that limits the growth rate of the firm – the so-called 'Penrose effect'.
- Excess capacity of productive services of resources is a driver of firm growth.
- Unused productive services of resources can be a source of innovation.
- A firm's diversification is often based on the firm's competencies that can lead to a sustainable competitive advantage.
- An important component of the competitive process is experimentation.

Hart and Dowell (2011) identified important areas that have emerged in the 15 years since the RBV was published, these include Pollution prevention, Product stewardship, clean technology, and capabilities needed to enable firms to succeed. Andersén (2021) conducted a study on relational natural-resource-based view on product innovation and concluded that green product innovation affects differentiation advantage, and the relationship is strengthened by having green suppliers. Furthermore, Filho and Moori (2020) affirm that RBV serves as a mediator between supply chain management and business performance.

Firms usually have a wide range of indicators to measure social and environmental performance, and the approach is dependent on a number of factors, of which the amount of resources is decisive (Shi *et al.*, 2012). According to Barney *et al.* (2001b), the value of a firm's capabilities is best evaluated in the market context in which it operates, not in the broader operating environment beyond that context. Furthermore, Luján Salazar (2017) studied the value in the RBV, arguing that value should be viewed in internal as well as external resources in a multi-level view, and that value emerges as a result of the combination of resources and capabilities in the firm's configuration.

2.2.3. Stakeholders Theory

The stakeholder theory emphasises that stakeholders (e.g., suppliers, employees, or communities) in the sustainable supply chain system are an integral part of the business and thus confer legitimacy on the firm (Menke *et al.*, 2021). Stakeholder theory posits that a company's stakeholders comprise the organisation itself and the various entities it impacts, including individuals, groups, communities, organisations, institutions, societies, and the natural environment, all of which can be seen as actual or potential stakeholders (Touboullic & Walker, 2015a). Stakeholders are categorised into primary and secondary groups. The primary group typically involves shareholders, investors, employees, customers, suppliers, and public stakeholders. Conversely, the secondary group comprises those who do not engage in business transactions and are not crucial for the company's survival, such as the media and other specialised stakeholder groups.

The dimensions of sustainable supply chain management are derived from customers' and stakeholders' requirements. This enables firms' performance in the management of material, information and capital flows (Seuring & Müller, 2008). The fundamental premise of stakeholder theory is that companies should not focus solely on shareholder financial gains but also strive to balance the interests of all stakeholders to mitigate the risks of moral hazard arising from managerial self-interest. Some researchers have indicated that building relationships with stakeholders can enhance company performance and, in turn, increase shareholders' wealth by fostering the development of intangible assets. Additionally, companies should proactively engage in CSR strategies, undertake CSR initiatives, and transparently share CSR information with stakeholders. Organisations that actively meet their responsibilities towards stakeholders often see improvements in their reputation and performance (Touboullic & Walker, 2015b; Stroumpoulis & Kopanaki, 2022). Thus, stakeholder theory highlights a potential source of competitive advantage for businesses and provides a theoretical foundation for achieving sustainable development by fulfilling social responsibilities (Awan *et al.*, 2017).

According to Menke *et al.* (2021), stakeholders can have three attributes: power, legitimacy, and urgency and are classified as primary stakeholders, which are interest groups with different rights, objectives, expectations and responsibilities, and secondary stakeholders that influence or are influenced by a firm's operations and are less essential for its survival. The key attributes of stakeholders, like urgency, legitimacy, and power, help companies to identify which stakeholders

they should prioritise in their CSR efforts. Stakeholders can help firms acquire and develop capabilities that are pivotal to meeting social sustainability requirements from customers and lay a better foundation for preserving employee health, improving employee productivity, and advancing society by adopting safety and green manufacturing (Awan *et al.*, 2017). The study by Awan *et al.* (2017) concludes that there is a significant positive relationship between the impact of stakeholders' pressure and the extent of using sustainable supply chain management.

Seuring and Müller (2008) argue that a more sustainable supply chain necessitates attention to supplier management for both risks and performance, as well as to sustainable product SCM. In supplier management focused on risks and performance, implementing environmental and social standards is a common practice to ensure a minimum level of performance. SCM for sustainable products is linked to supplier involvement and development within the context of SCM for sustainable products.

There is variation in the importance of stakeholders across organisations; however, suppliers and consumers are the most influential and relevant to all institutions, regardless of firm size. Severe competition has influenced firms to focus on collaboration between diverse stakeholders, sharing resources and knowledge. To this end, collaborations and partnerships offer an opportunity to broaden the stakeholder integration to achieve the firm's goal (Schonebeck & Pöllinger, 2020).

Siems and Seuring (2021) finds that, despite the essentiality of two-way communication with stakeholders for stakeholder management, an immense willingness to learn and transform the Sustainability system design is a precondition for genuine focus on stakeholder management in sustainable supply chain management. This includes a strong link between development and local inhabitants. Stakeholder pressure could serve as a means to gain more capabilities through the implementation of sustainable supply chain management (Awan *et al.*, 2017). Stakeholder pressure and sustainable supply chain management significantly contribute to firms' social and environmental sustainability performance, and collaborative work with all relevant stakeholders is essential for understanding these aspects and designing effective policies.

2.2.4. Institutional Theory

Meyer *et al.* (2013) emphasises that, *'Firms are driven to include the practices and procedures as a result of rationalised concepts of organisational setup, and this influences their legitimacy and survival prospects that leads to isomorphism; a phenomenon that forces firms to resemble*

one another'. Beckert, (2010) have identified three mechanisms in which institutional isomorphism occurs (Fields *et al.*, 2009; Beckert, 2010):

- Coercive isomorphism results from both formal and informal pressures exerted on organisations by other organisations, governmental and non-governmental, and partners. Coercive isomorphism arises from political influence and concerns about legitimacy.
- Mimetic isomorphism, in which the lack of a well-structured system forces organisations to import rules and practices from others to avoid failure.
- Normative isomorphism originates largely from the need to exercise professionalism in the respective organisation.

Institutional theory suggests that both internal and external social structures can influence an organisation's strategic choices or hinder its performance. These pressures from social structures or institutions prompt organisations to either adopt or abandon specific activities. The theory also indicates that companies are likely to react to environmental pressures to ensure their legitimacy and survival. External influences from social, political, and economic factors shape firms' strategies and their decisions to embrace accepted practices. By adopting these legitimate practices, businesses can achieve approval from their diverse stakeholders.

Researchers in supply chain management have investigated why certain sustainability practices are adopted by manufacturing companies in light of these pressures (coercive, mimetic, and normative). Given the increasing demands on manufacturing firms' supply chains to embrace sustainability, firms are likely to implement sustainable practices to enhance their legitimacy, profitability, and overall survival. Regardless of the cultural values at play, manufacturing companies are inclined to align their cultural practices with sustainability initiatives in order to improve their SSCP and gain legitimacy. This suggests a probable positive correlation between organisational culture and the adoption and performance of sustainability initiatives in manufacturing firms' supply chains. Therefore, it is believed that emphasising the various pressures arising from internal or external social structures is likely to have a beneficial impact on SSCP.

Apart from being entities with their own production systems, firms are integral parts of the social system, with their own culture and values. Firms' decisions emanate from organisational culture, values, norms, and principles, influenced by the external environment (Gualandris & Kalchschmidt, 2014). Firms in the same industry adopt similar institutional practices and

decision-making approaches to remain competitive and legitimise themselves. To this end, Institutional theory is used to identify external factors that compel firms to adopt new ways of doing things and practices (Saeed *et al.*, 2018).

Rational actors tend to standardise their organisations within a given set. External and internal pressures promote convergent business processes. Organisations are expected to behave rationally; therefore, rationalised myths, such as conduct guidelines, are accepted. These myths were formulated as responses to purported problems within organisations, and once they achieved broad acceptance, they were subsequently rationalised (Meyer *et al.*, 2013; Beckert, 2010). Organisations become more institutionalised by conforming to these myths, leading them towards isomorphism. Consequently, organisations face pressure to implement uniform structures and forms as a result of established myths (Fields *et al.*, 2009).

2.2.5. Transaction Cost Economics

Transaction Cost Economics (TCE) is one of the essential organisational theories in the field of organisational study. The vital aspect of TCE investigates how business partners collaborate with each other and protect each other from harmful and non-standard activities in their relationship (Shelanski & Klein, 1995). Furthermore, TCE supports the make or buy decision and the approval of the correct contract mode (Shelanski & Klein, 1995).

The variation in transaction characteristics leads to changes in transaction costs (Banterle & Stranieri, 2013). The need for positive transaction costs becomes apparent when there is a strong desire for the logic of zero transaction costs to completion (Williamson, 2008). The basic goal of the supply chain is to increase total supply chain profit for all members by reducing total supply chain cost (suppliers, manufacturers, distributors, and others who participate in this process). Improving total profitability for all supply chain partners is the ultimate objective of supply chain management. Without a solid foundation in the supply chain, achieving this aim may not be possible. However, collaboration is the first step in building confidence and achieving profitability for all participants in the supply chain (Vaidya, 2011).

According to Schwabe (2013), in TCE, a company may opt to outsource first if the total costs of the venture, including all expenses, are lower than the total costs of creating the same feature within the company. All things considered, this new institutional framework, which essentially

tracks costs, places restrictions on the likelihood of outsourcing. Moreover, in-house production is the final resort because it is the most difficult process (Williamson, 1979). TCE is part of the new institutional theory, which focuses on decisions in sourcing predicaments. The sourcing aspect of a firm is similarly described as the make-or-buy decision. The two principal drivers of TCE are external environmental uncertainty and costs, including coordination and transaction costs (Schwabe, 2013). Williamson (2008) also indicates that individual bounded rationality and opportunism influence uncertainty and costs. Human beings act in accordance with their objectivity and may act to favour themselves over the firm. Tate *et al.* (2011) argue that the performance of a buying firm improves when that firm's suppliers practice the environmental standards. Furthermore, the supply base and the supplier have a greater impact on the supply chain's environmental impact than the firms (Hoh & Tang, 2021).

According to Li and Fang (2022) transaction frequency negatively influences transaction costs. Moreover, learning about asset specificity and transaction uncertainty positively affects transaction costs. The major advantage and applications of TCE in the supply chain management lie in buyer-supplier linkages. TCE provides a description of firms for their vertical coordination within a supply chain and provides opportunities to evaluate many supply management-related issues (Garfamy, 2012).

2.3 Dimensions of Sustainable Supply Chain Management Practice

2.3.1 Environmental Sustainability

Depending on the size and nature of firms, many common barriers are faced by all firms, while others are applicable only to specific firms. According to Seuring *et al.* (2008) Firms operate under pressure in their supply chains, especially large and multinational organisations whose brand names are closest to the public eye and those with many consumers. Public scrutiny has increased as consumers have become more aware that it is not only the final product but also the supply chain that requires the closest supervision.

Pandey *et al.* (2021) have studied critical success factors for sustainable supply chain management and find that the current global context is witnessing a growing focus on environmental regulations, sustainability, and accountability in organisations. Consequently, firms can benefit greatly by adopting sustainable practices. Narayanan *et al.* (2019) analyse the barriers to sustainable supply chain management; they find that the growth of the industrial sector was rapid and strong after the globalisation of the Indian market. Many Indian companies adopt sustainable practices, including environmental standards and corporate social

responsibility initiatives. The adoption was further tightened after the government insisted on its implementation through different rules and regulations. Despite adoption, however, the practices face various implementation barriers due to traditional supply chain practices.

Diabat *et al.* (2013), in their study on green supply chain practices and performance, find that environmental sustainability is still a relatively new concept in many developing nations. Firms in developing countries have adopted international standards; however, they lack the necessary know-how, skills, and experience to implement them effectively. Moreover, Bag *et al.* (2015) have examined Sustainable Supply Chain Management within the context of the Indian Rubber Industry, concluding that the pre-liberalisation phase of the Indian economy was marked by excessive regulation and a closed economic system. Concurrent with its rapid economic growth, the Indian economy has suffered serious environmental damage from industrial expansion and operations. As a result, the government has emerged to implement environmental policies that can contribute to efficiency through technological innovation.

2.3.2 Economic Sustainability

Economic sustainability aspect can be considered as “financial” and “non-financial”, while the financial aspect focuses on financial performance measures such as return on assets and return on equity, the non-financial aspect includes environmental stewardship, community well-being and ethical conduct (Sudusinghe and Seuring 2020). Mefford (2011) finds that there are three areas of economic advantage that a firm can get for sustainability; first, the need of customers to purchase from firms acting in accordance with ethical consideration can yield benefit to the firm revenue, second better production system can attract quality workers, and third the low probability of lawsuits from potentially decreased probability of claims and lawsuits from customers, employees, and supplier help the stability of financial resource. Moreover, according to Brooker and Hayward (2018) employee morale and skill effects have a high impact on productivity and quality of the firms. Employees as an asset play a crucial role in creating quality products and improving productivity.

Sustainable development refers to utilising renewable natural resources in ways that do not deplete or degrade them, ensuring they remain available for future generations. Additionally, it involves using non-renewable mineral resources in a manner that allows future generations to access them easily. It also necessitates a gradual depletion of non-renewable energy resources to

facilitate a smooth transition to renewable alternatives. This definition primarily emphasises the physical dimensions of sustainable development. Alternative perspectives on resource management suggest that sustainability could be redefined so that current resource use does not compromise future real incomes. This implies that future generations should have equal access to the resource base. Furthermore, the integrity of natural resources and the environment is crucial for future economic activity, highlighting that economic advancement will increasingly rely on maintaining the resource and environmental foundation.

Recently, well-being has emerged as a crucial concept in sustainable development. Well-being encompasses the enjoyment derived from consuming various goods and services, including those provided freely by nature, such as the appreciation of a scenic sunset. In this sense, sustainable development aims to enhance "consumption" in its broadest economic context over the long term. Since 2008, the financial crisis centred in the United States of America, there has been a heightened focus on the economic aspects of development. The crisis underscores the importance of sustaining economic growth, which has been a global policy priority for the last years. This emphasis on growth has made it difficult to achieve a balance between sustainability and economic advancement. However, the economic crisis could serve as a catalyst for rethinking economic growth and framing a new economy around sustainable development. The significance of economic sustainability is now being increasingly acknowledged by leading political figures in major countries. As such, the on-going global economic crisis has highlighted the importance of the economic pillar and raised doubts about the viability of a development model centred solely on economic growth. This indicates the necessity to tackle economic challenges independently, without apparent ties to environmental concerns.

Improvements in quality, manufacturing processes, and workplace safety are other potential mechanisms for reducing risks brought about by socially responsible behaviour in the production sector. Lean supply chain practices' intrinsic principles increase productivity, dependability, and safety in production operations while enhancing quality. As quality rises, the number of product liability claims originating from flaws may decline.

According to Joshi (2022) reducing waste is the main indicator for economic sustainability to save money. Economic sustainability also includes components such as recycling, design/reverse logistics, reduced transportation costs, efficient packaging, and reduced energy consumption costs. Mefford (2011) stated that firms can reduce their financial risk with sustainable supply

chain practices; they can benefit from the reduction of financial costs. The deployment of risk management infrastructures, policies, and insurance against these risks costs businesses a lot of money. Any operational, strategic, and procedural measures that reduce these risks may be profitable for the company. Furthermore, Mokhtar *et al.* (2018) put forth that sales and net profit are the economic parameters that have the greatest impact on sustainability, whereas the cost of raw materials is displayed in the other direction.

2.3.3 Empowerment and Social Sustainability

The aspects of social sustainability are broad, given that it is correlated to a firm's influence on individuals and society's well-being (McWilliams and Siegel, 2001, & Mani *et al.*, 2016). The role of social sustainability can be viewed from two dimensions: internal and external social sustainability practices. The internal social sustainability practice construct focuses on practices that primarily impact the human factor (employees and workers) within the company, such as improving education and working conditions. The external social sustainability practice focuses on access to quality essential healthcare services, awareness of sustainable development and Philanthropic activities. Sudusinghe and Seuring (2020) further substantiate the idea by dividing it into two aspects from the perspective of a manufacturing firm: “*internally influencing social sustainability practices*” (ISSP) and “*externally influencing social sustainability practices*” (ESSP). The ESSP construct focuses on practices that ultimately benefit society at large, such as increasing employment opportunities for youth and improving the living conditions of surrounding communities. Consequently, the economic sustainability dimension was considered under the “Economic Performance” (EP) construct, focusing on practices that improve non-financial measures of the company, such as attracting new customers and employees while retaining existing ones.

The strategies for addressing the social dimension of sustainable development are as varied as those for the economic pillar. Social sustainability can be understood primarily from a social perspective, meaning that human well-being cannot thrive without a healthy environment and is also unlikely to flourish in the absence of a robust economy. Social sustainability requires maintaining societal cohesion and the collective ability to work towards common goals. Individual needs such as health and well-being, nutrition, shelter, education, and cultural expression must be met. However, it is arguably the social “pillar” of sustainable development

that is the most vital for the long-term survival of human civilisations. Human and social capitals are essential and represent a critical component of national wealth.

According to some researchers, socially conscious programs like SSCM may entail additional costs, such as developing environmentally friendly policies, training employees, and improving communities (McWilliams & Siegel, 2001). These extra expenses may then put businesses at a disadvantage in the marketplace. However, a growing number of studies like McWilliams and Siegel (2001), Arya and Zhang (2009), and Sarkis *et al.* (2011) have found that environmental responsiveness is positively correlated with firm performance, likely as a result of the positive effects that green supply-chain practices have on employee morale, customer satisfaction, and relationships with key stakeholders, including the government, which lowers regulatory costs, and investors, who increase investment in these companies.

Badri Ahmadi *et al.* (2017) emphasize that the lack of conceptual clarifications makes it difficult to determine "global and universal social sustainability metrics," particularly in the contexts of the industries and developing industrial countries. Therefore, the study includes many aspects of the social sustainability dimension in SCM literature. With the recently established socially sustainable practices serving as answers to the growing number of social problems, it has been difficult to comprehend the social sustainability dimension (Sudusinghe & Seuring, 2020b). Social sustainability practices are the ways a company manages people in its supply chain by addressing social issues, such as safety, health, hygiene, wages, and labour rights, as well as education, housing, and other factors that may affect the firm's sustainability. Social sustainability initiatives are required by legislation in affluent nations, but they haven't really taken off in developing economies (Mani *et al.*, 2015).

The adoption of social sustainability would be influenced by pressures given priority based on the needs of various stakeholders, categorised as definitive, expectant, or latent. To extend social sustainability throughout the supply chain, managers would select governance mechanisms through decision-making processes that account for behavioural factors. The governance systems chosen would then be related to social performance, which would also be impacted by crucial contingency elements like sector, material criticality, supplier reliance, and distance (Morais & Barbieri, 2022).

2.4 Sustainable Supply Chain Practices in Africa

This section discusses the sustainable supply chain practice in Africa. The global shift towards sustainability is redefining supply chain management, presenting both challenges and opportunities for African economies. Businesses are transitioning to responsible supply chain practices, necessitating transparency and ethical sourcing. The impact on African economies could be significant; there is potential for economic diversification and growth, and the movement towards sustainable practices offers Africa the chance to reshape its role in the global economy and promote inclusive development.

2.4.1 The Impact of Sustainable Supply Chains on African Economies

The increasing global focus on sustainability is reshaping supply chain management, presenting both challenges and opportunities for African economies. Companies around the world are re-evaluating their sourcing strategies to emphasise ethical practices and environmental stewardship, placing African nations in a pivotal position in this transformative shift. Historically, outsourcing production to countries with lower wages has been a fundamental aspect of Western business strategies. This cost-cutting approach has often resulted in negative consequences, prioritising inexpensive labour at the expense of social and environmental considerations (Chinwe Chinazo Okoye *et al.*, 2024).

Africa, with its abundant workforce and lower wage structures, has become an appealing option for businesses aiming to reduce production costs. However, this outsourcing trend has frequently led to serious human rights issues, including poor working conditions, child labour, and environmental harm, which have marred the reputations of multinational corporations. Considering the growing emphasis on sustainability, businesses are rethinking their supply chain strategies to adopt more environmentally and socially responsible practices (UNCTAD, 2023). This transition involves not only reducing the ecological footprint of production but also ensuring fair labour practices and decent working conditions throughout the supply chain. A key aspect of sustainable supply chains is transparency. Companies are now expected to provide clear insights into their supply chains, enabling stakeholders to trace product origins and evaluate suppliers' social and environmental practices. This transparency enhances accountability and enables consumers to make informed purchasing decisions. Ethical sourcing is becoming increasingly important, with companies seeking partnerships with suppliers that comply with rigorous labour and environmental standards. By investing in local communities, offering fair

wages, and supporting sustainable practices, businesses can promote long-term economic development and reduce the risks associated with unsustainable supply chain practices (Africa's Green Manufacturing Crossroads Choices for a Low-Carbon Industrial Future, 2021).

The effect of sustainable supply chains on African economies is significant. As companies shift towards sustainable practices, there will be a trend in sourcing raw materials and moving production closer to their markets. While this may lead to factory closures in Africa, resulting in job losses and economic challenges, it also offers Western companies an opportunity to promote economic diversification and stimulate growth among small and medium-sized enterprises across the continent. Faced with the need to look beyond low-cost competition, Western firms will need to adopt alternative strategies, such as investing in infrastructure, technology, and skills development in Africa while targeting African markets. This shift can significantly contribute to job creation, poverty reduction, and inclusive growth in Africa. Sustainable supply chains can transform entire business ecosystems, yielding both positive and negative outcomes. However, realising Africa's full potential requires coordinated efforts from governments, development agencies, and the private sector. Key actions include addressing infrastructure limitations, enhancing regulatory frameworks, and building institutional capacity to foster an environment conducive to sustainable investment and trade (Chinwe Chinazo Okoye *et al.*, 2024).

The move toward sustainable supply chains signifies a major shift in how companies perceive their responsibilities toward society and the environment. By prioritising ethics and sustainability over immediate profits, Western businesses can not only mitigate risks and improve their public image but also promote beneficial social and economic impacts for African economies. This transformative journey presents a unique chance for Africa to redefine its place in the global economy and pursue a path toward inclusive and sustainable development (Africa's Green Manufacturing Crossroads Choices for a Low-Carbon Industrial Future, 2021).

2.4.2 Africa's Emergence as a Key Player in the Global Supply Chains

Africa offers benefits such as easier, more direct access to essential resources, a youthful, tech-savvy workforce that is flexible and adaptable, and an emerging middle class characterised by an increasing appetite for advanced goods and services. Integrating deeper into global supply chains would also strengthen the diversity and resilience of African economies in facing future challenges. Expanding energy supply chains in Africa presents another opportunity to drive climate action forward (UNCTAD, 2023). The continent's immense renewable energy potential,

particularly in solar power, can lower production costs and reduce dependence on fossil fuels. The growth of investment in solar panel manufacturing could boost solar panel manufacturing on the continent. For instance, in 2022, the Democratic Republic of the Congo became Africa's leading copper producer, with 1.8 million metric tons, and beyond simply mining, the country has potential in refining metal products for the electric vehicle industry (Africa's Green Manufacturing Crossroads Choices for a Low-Carbon Industrial Future, 2021).

To tap into Africa's supply chain potential, there is a pressing need for investment in infrastructure, technology, and financing. Seventeen African nations, including Angola, Botswana, Ghana, and South Africa, have adopted local content policies to stimulate domestic supply chain development, promote technology transfer, create jobs, and add value locally. Furthermore, African nations should work towards securing improved mining contracts and exploration licenses for the metals essential to high-tech products. This would help strengthen domestic industries, allowing local companies to design, procure, manufacture, and supply necessary components. The implementation of innovative digital technologies is crucial for optimising supply chain processes. Countries like Kenya have made significant strides in this area, as digital skills are increasingly adopted across Africa. UNCTAD encourages governments to establish sound policies, create a supportive regulatory framework, and enhance programs that promote the widespread use of these technologies (UNCTAD, 2023).

2.4.3 Challenges in Implementing Sustainable Supply Chain Practices in the African Manufacturing Industry

Various studies have shown that African manufacturers face numerous obstacles when implementing sustainable supply chain practices. Some of these challenges include limited financial resources, limited investment in renewable energy (currently, only about 2% of global renewable energy investments are allocated to Africa), poor infrastructure, insufficient stakeholder support, and external factors such as weak government policies and unstable political conditions. Regulatory frameworks have a significant impact on how manufacturers adopt sustainable supply chain practices (Africa's Green Manufacturing Crossroads Choices for a Low-Carbon Industrial Future, 2021). Prior research has examined how regulatory constraints affect the quality of sustainability reporting. It has also been found that implementing new regulatory standards enhances the quality of sustainability reporting. This suggests that even while legislative requirements could be beneficial, attaining uniform sustainability reporting

quality remains difficult for the African manufacturing industry. Adhering to sustainable supply chain principles presents difficulties for African manufacturers. The significance of capacity building in sustainable internationalisation strategies emphasises the critical requirement for knowledge and skills in sustainable practices. To overcome these obstacles and guarantee that African companies can successfully incorporate sustainable practices into their supply chains, further efforts are needed. Africa must eliminate obstacles to supply chain finance, such as regulatory hurdles, high perceived risks, and lack of credit information. Concerned International bodies should also call for debt relief to give African countries the fiscal flexibility needed to invest in strengthening their supply chains, noting that they have limited financial resources and they on average, incur four times the borrowing costs of the United States and eight times more in comparison to others (Africa's Green Manufacturing Crossroads Choices for a Low-Carbon Industrial Future, 2021).

The UN trade and development body also stresses the need for better financing solutions that provide African nations and businesses with affordable capital and liquidity for enhancing their supply chains. For small and medium-sized enterprises, the UNCTAD (2023) report highlights that increased supply chain finance is essential to close the payment gap between buyers and sellers, improve access to working capital, and alleviate financial pressures. Other challenges in implementing sustainable supply chains in African countries include a lack of worker development initiatives and poor infrastructure, both of which significantly impact the successful adoption of sustainable supply chain practices. Addressing these challenges to establish sustainable supply chains requires careful consideration of infrastructure constraints, legal frameworks, and capacity-building. Although legislative regulations can improve the accuracy of sustainability reporting, there are still obstacles to overcome, especially for African enterprises. Addressing the complex issues in sustainable supply chains requires overcoming infrastructure constraints and investing in capacity building (Chinwe *et al.*, 2024).

2.4.3.1 Water Availability in Africa

One irreplaceable resource is water. The United Nations General Assembly on July 28, 2010, acknowledged access to sanitary facilities and safe, clean drinking water as a basic human right. Furthermore, the global goals of guaranteeing "*safe and affordable water for everyone*" and halting the degradation of freshwater habitats are delineated in Sustainable Development Goal 6. The least developed nations in sub-Saharan Africa struggle with limited access to clean, fresh

water, which may be exasperated as demand for water continues to rise. The depletion of natural resources is driving people to migrate to urban areas, which places additional strain on urban infrastructure. Those living in poverty within cities are particularly at risk from climate-related shocks and water scarcity. Rapid population growth in African cities, combined with the pollution of existing water sources, creates a significant imbalance between the demand for and the supply of water (Engdaw, 2020).

The disparity between water demand and supply is expected to grow due to climate change, making it essential for governments to implement sustainable water pricing while engaging local communities. In arid and semi-arid areas, the limited availability of surface water heightens the reliance on groundwater resources. Over-extraction and insufficient recharge are leading to the deterioration of groundwater quality in African nations. Nonetheless, significant seasonal rainfall events linked to the Indian Ocean Dipole and the El Niño Southern Oscillation provide some replenishment to groundwater. Conversely, drought conditions and restricted access to water are prompting local conflicts and protests in sub-Saharan Africa. As climate change reduces rainfall and raises temperatures, the challenges faced by African countries may intensify. Despite having the second-highest population in Sub-Saharan Africa, Ethiopia has the lowest percentage of drinking water availability in the area (52%) (Wubneh *et al.*, 2023).

In developing countries in Africa, seasonal forecasts are limited, and their availability would benefit water resource managers in addressing the adverse impacts of climate change in urban areas. Promoting resilience development among global communities, particularly in Africa, will enable better management of urban water resources in the face of potential impacts and risks from future climate change. In the near future, it is important to transform “supply-based management” into a “demand-based management” system to manage better distribution of water in urban areas of developing countries.

2.4.3.2 The Influence of Urbanisation or Industries on Climate Change

Global temperatures are raising due to increased greenhouse gas (GHG) emissions from human activity. The hydrological cycle is affected by changes in global temperatures, which also accelerate glacier melting. Water availability is influenced by both population and climatic variables. People are migrating to cities due to the lack of job prospects and population growth in rural regions. The emergence of urban heat islands at the local level is one example of how the growth of urban areas and economic activity alters the landscape pattern. The phenomenon

known as an urban heat island occurs when solar radiation is absorbed or retained by urban infrastructures, raising city temperatures (Engdaw, 2020).

2.4.3.3 Industries' Effect on Water Supply

GHG emissions from many businesses play a major role in climate change. Apart from greenhouse gases, nearby areas may get contaminated fresh water due to industrial wastewater and effluent discharge. Water resource pollution hazards are decreased by remediation and appropriate waste management. It might be difficult to adopt appropriate hazardous waste management rules in harsh climates. This implies that waste management may become more challenging in the future amid climatic extremes. Furthermore, downstream surface water resources are contaminated by runoff from industrial operations. Water quality downstream will be severely degraded by climate change-induced high-intensity, frequent discharges. Therefore, the quality of freshwater supplies is likewise deteriorated by climate change. Production expenses are raised by the high cost of treating industrial effluents (Wubneh *et al.*, 2023).

2.4.3.4 Climate Change's Effects on Urban Water Resources' Accessibility

Climate change increases the risks associated with hydrology and reduces the quantity and quality of water. Variations in glacier melting driven by climate change degrade river and lake water quality, affecting physicochemical and biological factors. Climate change is threatening the world's major rivers through pollution and fluctuations in stream flow. Water shortages are caused by summer flow decreases, whereas floods are caused by spring flow rises. The recurrent floods and droughts that follow throw the water supply management system out of balance. Fresh water supplies are under pressure due to population growth, which also increases water demand. Utilising cutting-edge technologies to treat wastewater lessens the demand on freshwater supplies and improves urban water security. Future water shortages will result from the urban population increase, and the effects of climate change will make matters worse. Urban areas have less water available due to population expansion, climate change, and rising per capita usage. Water quality and quantity are negatively impacted by climate change, and urban populations are more susceptible to water-related risks. There is an urgent need to address the issue, as the effects of climate change on urban water availability require greater attention than population growth, and per capita water use will have a major impact on output, leading to a food shortage. To provide water security for the urban population, water distribution and rights

are also crucial. Seasonal variations and climate-driven variables also influence the difference in water distribution between senior (agricultural and environmental flow) and junior (urban) water right holders. Because of internal unpredictability, junior water right holders are more unsure than senior ones. Climate change-related reductions in agricultural water supply will have a major effect on production and lead to a shortage of food (Wubneh *et al.*, 2023).

2.4.3.5 Industrial Waste

A wide range of manufacturing processes generates many different types of industrial waste. The waste generated by a car factory will differ from that of a steel mill, for example. Industrial waste is a broad term that encompasses many types of waste. The primary source of industrial waste is by-products generated by various manufacturing processes. These waste materials can arise from a variety of production activities, such as vehicle assembly in factories or chemical creations in laboratories. While many of these by-products are generated as a necessary part of production, they often cannot be repurposed. Industrial waste is produced by a range of sectors, including food processing, chemical production, and metal fabrication, pharmaceuticals, and oil and gas extraction. Poor waste management practices can increase industrial waste, harming the environment. It is crucial for all industries to implement measures to minimise waste and manage disposal responsibly (Engdaw, 2020; Melkie, 2022).

The World Bank report (UNCTAD, 2023) shows that 9.2 billion tons of industrial waste are generated worldwide each year. This trash originates from production processes and is often a by-product with no further use. It encompasses diverse types of waste, including solids, chemicals, and liquids produced by factories, laboratories, construction sites, mills, and other establishments. The environmental consequences of industrial waste are considerable, regardless of its classification as hazardous or non-hazardous. It adversely affects ecosystems and marine organisms, pollutes water supplies, and exacerbates air pollution by emitting greenhouse gases. Efficient handling of industrial waste is essential to alleviate these dangers. Examine the seriousness of the challenges associated with the generation, management, and disposal of industrial waste through these enlightening facts (UNCTAD, 2023).

Analysing statistical data and facts regarding industrial waste can be complex due to the wide range of categories it includes. While extensive research exists for specific industries and waste

types, detailed information on overall industrial waste is less common. Nevertheless, the World Bank UNCTAD (2023), reports highlights several key facts about industrial waste: approximately 2 billion tonnes are generated each year globally, with nearly half of all waste attributed to industrial activities. The World Bank (UNCTAD, 2023) report further shows that just over two billion tonnes of industrial waste fall under the municipal solid waste classification. Unfortunately, about one-third of this municipal solid waste is inadequately managed or disposed of. Only 2% of the total global industrial waste is deemed recyclable. For instance, the UK alone generates 41.1 million tonnes of industrial waste annually, whereas American industries produce considerably more, around 6 billion tonnes of industrial solid waste each year. Furthermore, 50% of US lakes are affected by industrial pollution. In developing countries, approximately 70% of industrial waste is released without treatment. Roughly 40% of all industrial waste is sent to landfills, and by-products from industrial processes account for half of the total global industrial waste generated. Additionally, paper is a significant contributor to industrial waste (UNCTAD, 2023).

2.5 Empirical Analysis

While there are motivations for sustainable supply chain management, pursuing it is not uncomplicated, as organisations encounter several challenges. This section presents an empirical analysis of the drivers and barriers to sustainable supply chain management to support improved forecasting of challenges in its implementation.

2.5.1 Drivers of Sustainable Supply Chain

Sustainable supply chain management drivers are pressures, triggers, and enablers that demand a firm to implement sustainable practices. SSCM drivers motivate firms to adopt sustainability initiatives across the supply chain. Usually, the pressure emanates from internal and external stakeholders (Hsu *et al.*, 2013). Moreover according to Saeed and Kersten (2019) the digitalisation of the global economy and the expansion of information and communication have awakened consumers to the sustainability of the products they purchase.

The work by Alzawawi, (2014) on the Drivers and Obstacles for creating Sustainable Supply Chain Management and Operations, finds that financial benefits have the greatest influence in the adoption of sustainable practices in the supply chain systems, followed by government regulations. The study also indicated suppliers as the least influential driver, and a lack of knowledge was found to be a major obstacle to sustainable supply chain practices. Saeed and

Kersten (2019) emphasised that both drivers of SSCM and decision-making concerning sustainability are interlinked, and this enables firms to lead towards improved sustainable behaviours. They further find that external drivers, such as market and regulatory pressures and corporate strategy, are more significant in adopting sustainability practices than internal drivers. Along the supply chain, suppliers, management, and customers can influence organisational practices to make future development more sustainable. The following table summarizes external and internal drivers of sustainable supply chain sustainability.

Table 3 Driver of Sustainability Practice

External Drivers	Internal Drivers
▪ Regulatory pressures	▪ Strategy
▪ Societal pressures	▪ Organisation's culture
▪ Competitors/Market Pressures	▪ Organisation's resources

2.5.1.1 External Drivers

External drivers emanate from outside the firms and are considered more influential than internal drivers. The external drivers include regulatory, societal, and market pressures.

2.5.1.1.1 Regulatory pressures

Regulatory pressure takes the form of standards, laws, procedures, and incentives set by regulatory institutions to promote sustainable practices. The regulatory pressures are imposed by the government and regulatory bodies (Hsu *et al.*, 2013). The regulatory pressure includes government pressure, trade associations, and other international and national regulatory institutions. Government legislation relates to existing and forthcoming regulations. Legislation has a strong impact on creating awareness and influencing firms to implement sustainability practices. The imposition of legislation can differ from a certain nation to another (Schrettle *et al.*, 2014; Beamon, 1999). Saeed and Kersten (2019) also been identified that professional and trade associations exert significant pressure to enforce sustainability practices. International standards and guidelines like the International Organisation for Standardisation (ISO) and the Occupational Health and Safety Assessment Series (OHSAS) encourage firms to implement sustainability (Beamon, 1999). Firms are also influenced by financial incentives from external organisations, such as tax exemptions. Moreover, some firms act proactively in practising sustainability as part of their corporate social responsibility (Caniato *et al.*, 2012).

2.5.1.1.2 Societal Pressures

Societal pressures are expectations and demands of interest groups to adopt sustainability practices in their operations. These pressures improve public awareness of sustainability issues such as resource scarcity, environmental and climate damage, human rights, and health and safety (Schrettle *et al.*, 2014). The societal pressures include NGOs, media/press, local inhabitants, value-based networks, consumer organisations, and the community (M. A. Saeed *et al.*, 2017). Both NGOs and the media/press raise consumers' awareness of organisations' social and environmental practices. Furthermore, value-based networks, such as scientific communities, can also influence organisations to adopt innovative approaches to achieving sustainability goals. According to Weldemichael and Gebremichael (2017), firms act unilaterally to reduce environmental impact, thereby ignoring the interests of the community in environmental issues. This finding substantiates the importance of interest groups in compelling firms to address sustainability issues.

To comply with societal expectations, norms, and codes of conduct that specify proper corporate activity, a company may feel a voluntary commitment to society. These businesses consequently implement environmentally friendly practices to create a socially acceptable brand that aligns with the duties and ideals of the society in which they operate. Researchers have also observed that businesses have a duty to manufacture environmentally friendly products to fulfil their corporate goal of social responsibility (Hsu *et al.*, 2013).

2.5.1.1.3 Competitor/Market Pressures

Large manufacturing firms face intense pressure to implement sustainability initiatives to respond to competition and gain a competitive advantage. Understanding pollution prevention, product stewardship, and sustainable strategies is essential to achieving a competitive advantage (Zhu, Tian, *et al.*, 2012). The market/competitors' pressure significantly shapes the market as it originates from customers, competitors, shareholders, suppliers and buyers, investors, reputation, financial institutions, supply chain, and network (Govindan *et al.*, 2016; Zhu *et al.*, 2012a).

2.5.1.2 Internal Drivers

Internal drivers are pressures emanating from the firm; they include corporate strategy, the organisation's culture, its resources, and its characteristics.

2.5.2.1 Corporate Strategy

The prerequisite for achieving the organisation's sustainability goals is the strategic integration of sustainability principles. This collection of drivers comprises top management commitment, cost-related challenges, operational performance, and organisational sustainability plan (Schrettle *et al.*, 2014; Hsu *et al.*, 2013; Govindan *et al.*, 2016).

As part of the organisational strategy, Internal environmental management is one of the most important sustainability practices to improve their environmental performance (Zhu *et al.*, 2008). Firms' lagging internal environmental management practices pose numerous challenges due to regulations in export-receiving countries, such as the EU's regulations. This leads firms to take measures to close the loop in their supply chains.

A firm's corporate strategy includes specific objectives in green procurement, including recruitment. Consider purchasing materials composed of less-polluting materials, using fewer materials, and using renewable and recyclable resources to reach your end users. The firm's corporate strategy is also designed to foster employees' commitment to environmental issues, thereby significantly enhancing sustainability practices (Tay *et al.*, 2015). As supply chains span from the initial processing of raw materials to delivery to the final customer, corporate strategy must include broader adoption and implementation of sustainability practices. The strategy also explores new business models with suppliers, including co-branding opportunities. As such, companies must continue to develop sophisticated new tools to measure and share the benefits of sustainable practices among supply chain stakeholders. This allows users to assess the entire business ecosystem, including sustainability, when assessing the total cost of economic activity (Tay *et al.*, 2015).

2.5.2.2 Organisation's Culture

A company's culture directly affects its drive for sustainability. This includes communication of information, originality, concerns with health and safety, and codes of behaviour (Schrettle *et al.*, 2014, & Govindan *et al.*, 2016). According to institutional theory, a firm's logical desire to copy behaviours it considers technically useful is what drives cultural-cognitive isomorphism. The activities in the green supply chain, such as green purchasing and reverse logistics, are significantly impacted by socio-cultural responsibility (Hsu *et al.*, 2013).

Socio-cultural responsibility is an organisation's moral duty to the community in which it operates, demonstrated through voluntary attempts to conform to social norms and expectations

(Hu and Hsu, 2010; Hsu *et al.*, 2013). The desire of an organisation to alter and enhance the current sustainability practices requires the creation of fresh concepts to achieve sustainability objectives that also motivate the firm to adopt sustainability practices (Gualandris & Kalchschmidt, 2014).

Using a code of corporate behaviour as a driver, an organisation can make decisions, follow procedures, and implement systems that are consistent and match stakeholders' expectations (Alzawawi, 2014). Furthermore, implementing sustainable practices requires exchanging information on sustainability both internally and externally. It fosters cooperation within the supply chain and fosters the generation of fresh ideas. Firms are under pressure to report and reduce work-related health and safety accidents from a variety of stakeholders (including NGOs and the media) (Saeed and Kersten, 2019; Govindan *et al.*, 2016).

2.5.2.3 Organisation's Resources

Resource sufficiency is an important driver in achieving sustainability goals by an organisation. This driver category includes resource depletion, human capital, organisational capabilities and development of new technology (Schrettle *et al.*, 2014; Saeed *et al.*, 2017). This internal driver can also include working with suppliers to discover ecologically friendly goods and equipment. To generate business profits, every company aspires to lower costs. The ability of a firm to reduce its financial resources can be greatly increased by incorporating sustainability into supply chain activities (Alzawawi, 2014).

An organisation's sustainability initiatives are driven by the availability of sufficient resources, which also promotes the adoption of sustainable policies. Organisations are under pressure to use natural resources as efficiently as possible due to resource depletion, which is a driver of sustainability measures. Moreover, well-trained human capital enhances professional and managerial capabilities, hence encouraging the implementation of sustainability-related initiatives. Furthermore, Human capital (skills and capabilities) plays a significant role in embracing professional competence and managerial capacities by putting sustainability-related measures into practice (Govindan *et al.*, 2016; Schrettle *et al.*, 2014; Zhu and Sarkis, 2004). Employees exert internal pressure on firms to embrace sustainable practices either on their own or through their unions. Additional forces behind the sustainability approach include the

development of new technology and apparatus, as well as training and development (Govindan *et al.*, 2016; Saeed and Kersten, 2019).

2.6 Sustainable Supply Chain Management and Firm Performance

In the past few decades, firms have shown a growing concern for sustainability due to its immediate impact on firm performance. Sustainable supply chain management benefits firms by increasing efficiency, enhancing product quality, helping them compete with competitors and comply with legislation, opening access to new markets, boosting employee motivation and satisfaction, improving public relations, and strengthening the firm's reputation. Ortas *et al.* (2014a) argue that financial usefulness promotes the implementation of sustainability practices in companies' supply chains. Furthermore, (Ortas *et al.*, 2014a) finds a conflicting assessment about the relationship between sustainable supply chain performance and companies' financial performance. One assessment is that the best financial performers allocate few resources to improving their sustainable supply chain performance. Another assessment is that companies that improve their sustainable supply chain performance through their commitment to environmental, economic, and social concerns also improve their financial performance. This assessment validates that addressing environmental, economic, and social issues as part of corporate strategy can generate new opportunities for competition and new ways to add value and improve long-term financial performance.

In sustainable supply chains, environmental and empowerment criteria are expected to be fulfilled by supply chain members to remain within the supply chain, while it is expected that competitiveness is the result of meeting customers' needs and related economic measures (Seuring *et al.*, 2008). Sustainable supply chain management performance is highly dependent on dedicated leadership and employees. Not only should managers be optimistic about sustainability issues, but employees should also have a positive tendency and commitment to sustainability for successful implementation. This shows managers' support and attitude, as well as employees' motivation, drives internal organisational procedures to implement an effective SSCM strategy (Emamisaleh & Taimouri, 2021). Emamisaleh and Taimouri (2021) further highlights that if sustainable supply chain management practices are amalgamated with the strategies of a company it yields positive impacts on firm's operational performance.

According to Nayak and Dhaigude (2019), financial constraints, organisational management support, competition, culture, infrastructure, and planning and execution are the most influential independent variables, while people, customer acceptance, government support, supplier acceptance and external stakeholders are identified as outcome variables in the implementation of SSCM. Govindan *et al.* (2020) examine the Natural Resource-Based View (NRBV) within the context of the supply chain and find that environmentally sensitive operations and practices within a company's supply chain result in better firm performance. They further explain, using the instrumental stakeholder theory, that firms with highly ethical relationships with stakeholders experience high levels of trust and cooperation. Gavronski *et al.* (2011) indicate that improvements in firm performance result from increased operational performance driven by improved collaboration between suppliers. Besides, Gavronski *et al.*, (2011) show that the introduction of environmentally specific capabilities can improve operational performance. The improvement in firm performance can also be due to higher margins from the sale of environmentally friendly products to environmentally conscious customers (Kim *et al.*, 2018; Han & Kim, 2010; Sheu & Choi, 2019). Govindan *et al.* (2020) conclude that socially responsible practices improve firm performance by reducing supply chain risk and increasing stakeholder involvement; thus, socially responsible sustainability practices are positively correlated with firm performance. Most developed nations are increasingly integrating sustainability principles into their supply chains, whereas less developed nations are less so. Morali and Searcy (2013) have reviewed sustainable supply chain management practices in developed nations and found that 62% of corporations in the manufacturing and financial sectors disclose their corporate sustainability initiatives.

2.7 Ethiopian Laws and Regulations Pertinent to Sustainable Supply Chain Practice as Drivers Specific to Ethiopia

2.7.1 Review of Environmental Impact Assessment Proclamation No. 299/2002

The Environmental Impact Assessment (EIA) Proclamation No. 299/2002 is a vital legislative framework that ensures manufacturing operations are conducted in an environmentally responsible manner. According to Article 3, the authority or the appropriate regional environmental agency may determine that the manufacturing industry's potential impact needs to be evaluated. Before granting investment permission, a trade license, or an operating license,

licensing authorities must ensure that the EIA standards have been met. Criteria for determining impact are outlined in Article 4. Impact assessments are covered in Article 6 for projects that are anticipated to affect the environment. In line with Article 9, the Authority will decide on the submitted project or EIA. This Proclamation's other clauses address the following topics: the appearance of new circumstances (Article 11), monitoring of implementation (Article 12), EIA of a public instrument (Article 13), agency jurisdiction (Article 14), public engagement (Article 15), and other topics. Penalties and offences are outlined in Article 18. The principal objective of EIA Proclamation No. 299/2002 is to mandate that all manufacturing industries and developmental actors in Ethiopia conduct environmental impact assessment to assess their potential environmental consequences.

As per the proclamation, if manufacturing industries do not operate in accordance with the commitments made or obligations imposed, the Authority or the pertinent regional environmental agency is mandated to designate corrective actions. Any other authorising or licensing agency shall, concurrently with the Authority's or the pertinent regional environmental agency's decision to suspend or revoke any authorisation for the operation of the manufacturing industry, suspend or revoke the license it may have issued for the project. The Authority or the pertinent regional environmental agency shall ensure that public opinions, particularly from populations potentially impacted by the project's implementation, are integrated into the environmental impact study report and its assessment.

Ethiopia's EIA Proclamation No. 299/2002 addresses manufacturing industries failing to implement environmental sustainability throughout their supply chains. The explicit mechanism for delineating techniques for achieving sustainability across supply chains, especially in emerging economies like Ethiopia, has shown little applicability in manufacturing contexts.

2.7.2 Review of Ethiopian Labour Law Proclamation 1156/2019

The House of People's Representatives ratified Labour Proclamation No. 1156/2019, which abrogates Labour Proclamation No. 377/2003 and its revisions. The Proclamation supersedes a statute that has been effective for the past 16 years. This period has witnessed significant transformations in Ethiopia's investment climate, corporate environment, and overall labour market.

It pertains to employment relations formed via a contract between an employee and an employer,

encompassing the complete recruitment process. Employment relations between Ethiopian nationals and foreign diplomatic missions or international organisations operating within Ethiopia's territory are governed by this proclamation, unless the Council of Ministers stipulates otherwise through regulations, or an international agreement signed by Ethiopia establishes different rules.

This proclamation is a fundamental labour statute in Ethiopia, and comprehending its applicability is crucial for both employers and employees. It predominantly addresses employment relations regulated by contracts of employment while omitting specific types of work relationships. Moreover, there are exceptions and laws that clarify its validity in specific situations. All relevant parties must be aware of these laws to ensure legal compliance. Employers are required to preserve precise records of wage payments, encompassing amounts, methods, and deductions. These records must be accessible to employees upon request and are subject to inspections by labour authorities (Article 57(3)). The Ethiopian Labour Proclamation establishes a thorough structure for the determination and payment of wages.

Establishing explicit criteria guarantees equitable compensation and fosters amicable employment relationships. Understanding these regulations is crucial for both employers and employees to effectively exercise their rights and fulfil their responsibilities. The new Proclamation recognises the essential contribution of a proficient and disciplined workforce to Ethiopia's industrialisation initiatives and enhancement of its global competitiveness, explicitly articulating in its preamble the necessity of establishing a conducive investment climate.

2.7.3 Review of Ethiopia Investment Proclamation No. 1180/2020

Ethiopia Investment Proclamation No. 1180/2020 is a key legal reform that promotes and governs investment in Ethiopia. It superseded the former Investment Proclamation No. 847/1997 and aims to enhance Ethiopia's appeal as a destination for both local and foreign investment, while fostering sustainable economic growth and development. The Proclamation addresses various matters, including the extent of investments, the rights and responsibilities of investors, tax incentives, and the institutional structure for investment regulation. Investments pertaining to the exploration and development of minerals and petroleum are excluded from the purview of the new investment proclamation. A distinct legal framework will regulate investments in these sectors. Consequently, akin to the revoked proclamation, the Ethiopian Civil Aviation Authority, the Ethiopian Energy Authority, and the Ethiopian

Communications Authority were assigned the responsibility to license investors in their respective sectors.

The revised investment proclamation has transitioned from a positive listing method, which enumerated sectors permitted for foreign investment, to a negative listing approach, which identifies sectors prohibited for foreign investors. The investment regulation, which has yet to be approved, will specify the areas that are closed to foreign investors. This is generally regarded as a favourable development, as it broadens the sectors in which foreign investors may participate. The new investment announcement notably eliminated the areas formerly designated for government monopoly. According to the new investment decree, no industry will be allocated exclusively to the government. The new sector listing comprises four primary categories: those designated for joint ventures with the government, sectors allocated for domestic investors, and those reserved for joint ventures between foreign and domestic investors. Any sector not explicitly identified among the categories will be accessible to foreign investors.

The primary alteration enacted by Proclamation No. 1180/2020 is its embrace of an open policy towards foreign investment within the nation. It has permitted international investors to access all investment sectors, apart from those designated for: (a) joint ventures with the government, (b) domestic investors, and (c) joint ventures with domestic investors. Consequently, the forthcoming implementation rule of the new proclamation, anticipated to be approved imminently by the Council of Ministers, will be highly significant. The prior proclamation pre-emptively designated investment regions reserved for the government or for joint ventures with the government, and empowered the Council of Ministers to promulgate a regulation permitting private investors in these areas. Under the new proclamation, sectors designated for joint investment with the government and for collaborative investment with domestic investors would be delineated by regulation.

A recent development is the establishment of restricted investment areas for "joint investment with domestic investors," a category previously omitted from the prior proclamation. The new proclamation upholds the previous proclamation's stipulations regarding the minimum capital requirements for foreign investors investing in Ethiopia. The new decree exempts foreign investors designated as board members of private limited businesses converted into share companies from fulfilling the minimum capital requirement. A foreign investor acquiring the entirety of, or shares in, an existing firm owned by another foreign investor is exempt from the

minimum capital requirement. This variation seems to preclude the acquisition of investments held by a domestic investor, which must therefore satisfy the minimum capital requirement—unless, naturally, a foreign investor is deemed to be reinvesting profits or dividends derived from their existing enterprise into any investment sector accessible to foreign investors.

The issuance and renewal of investment permits will be handled by the EIC, and investors must obtain an investment permit to initiate projects in Ethiopia. An investment permit is valid solely until the company commences operations and obtains a business license to sell its products. According to the revoked investment proclamation, an investment permit is valid for only one year. If an investor fails to complete the project and achieve operational status within a year, they must provide a good justification to the EIC, which may then extend the investment permission for an extra year. The revised investment proclamation maintains the renewal term at one year while extending the validity period to two years.

A foreign investor intending to acquire an existing firm for continued operation or to purchase shares of such an enterprise must receive prior clearance from the Ethiopian Investment Commission (EIC). This service was previously offered at the Ministry of Trade. The inconsistent application of investment laws by the two entities has historically posed an issue.

2.7.4 Review of Environmental Pollution Control Proclamation No. 300/2002

Proclamation No. 300/2002 about Environmental Pollution Control delineates ambient air quality criteria and permissible emissions. The Proclamation comprises 22 articles with six Parts: Preliminary provisions, Pollution control measures, Environmental regulations, Environmental inspection personnel, Offences and sanctions, and various provisions. Article 3 of Proclamation No. 300/2002 delineates overarching regulations on pollution control and prevention, including the utilisation of clean technologies and the polluter-pays principle. Article 4 pertains to hazardous waste, chemical substances, and radioactive materials. Article 5 stipulates the collection, transportation, and treatment (including recycling) of municipal trash. The Environmental Protection Authority has established practicable environmental standards grounded in scientific and environmental principles. The criteria shall, at a minimum, pertain to discharge or effluent wastewater and sewage, air pollution, subsoil, noise, and waste management (Article 6). Environmental Inspectors shall be appointed by the Authority or the Regional Environmental Agency. The powers and responsibilities of the Inspectors are

delineated in Article 8. Inspectors may mandate corrective measures if any activity harms the environment. One may appeal against the decisions of Inspectors pursuant to Article 9.

The regulatory framework for air pollution control in Ethiopia is delineated by two articles that outline the procedure for establishing air quality standards. The FDRE Environmental Policy establishes the legal foundation for climate change in the country.

This declaration, designated as Proclamation No. 300/2002 by the Ethiopian parliament, was enacted to safeguard the environment from pollution and to complement the Environmental Impact Assessment Proclamation. The preamble to the proclamation states that certain social and economic development efforts may cause environmental damage; therefore, environmental protection is a collective responsibility, and the enactment of laws to eliminate or mitigate pollution is necessary. The preamble elucidates the need to enact environmental legislation to mitigate or prevent ecological damage and pollution.

2.7.5 Review of the Ethiopian Wildlife Development, Conservation, and Utilisation Proclamation No. 541/2007

Certain manufacturing companies in Ethiopia are located near areas designated for wildlife conservation. This underscores the need for proclamation to preserve wildlife. The Ethiopian Wildlife Development, Conservation, and Utilisation Proclamation addresses the development, conservation, and sustainable exploitation of wildlife resources in Ethiopia, encompassing both native wild animals and migratory species that temporarily inhabit the country. Wildlife conservation areas, designated and managed by the Federal Government, shall encompass: (a) national parks of national and global significance, characterised by representative ecological zones and substantial wildlife diversity; (b) national parks and wildlife sanctuaries that host the nation's endemic and endangered species; (c) any wildlife conservation areas located across two or more regions; and (d) any trans boundary wildlife conservation areas established pursuant to agreements with neighbouring countries. Other wildlife conservation zones shall be managed by designated regions or overseen by private investors or local populations. Additional stipulations of this Proclamation pertain to the permission for activities, such as hunting, within wildlife protection areas, and to the authorities' authority to formulate regulations.

2.7.6 Review of Ethiopian Renewable Energy Development Proclamation No. 810/2013

Ethiopia has significant potential for renewable energy, including hydropower, wind, and solar.

This legislation facilitates the advancement of renewable energy initiatives and delineates the legal structure for energy production and consumption. For enterprises engaged in manufacturing and supply chains, using renewable energy sources aligns with sustainable supply chain practices.

This Proclamation mandates the establishment of the Ethiopian Energy Authority through Regulation, delineates the Authority's functions, and stipulates the regulations for the generation, transmission, distribution, sale, importation, or exportation of electricity. It also creates the Energy Efficiency and Conservation Fund. Anyone intending to create, transfer, or distribute electricity for non-commercial purposes must notify the Authority in advance and provide documentation demonstrating compliance with environmental protection and safety requirements. The Proclamation addresses land utilisation for the generation, transmission, or distribution of electricity, land expropriation, and energy efficiency and conservation. The Authority will formulate and execute national energy efficiency and conservation plans and initiatives. Any individual intending to create, transfer, or distribute electricity for non-commercial purposes must notify the Authority in advance and provide supporting documentation that they meet the requirements for environmental protection and safety, and that their licenses adhere to this Proclamation, along with the regulations and directives established herein and in the applicable environmental protection legislation.

The Ethiopian Energy Authority (EEA) was established by Proclamation 810/2013, which superseded the Electricity Proclamation No. 86/1997 and the Council of Ministers Energy Regulation 447/2019, granting it the legal authority to control the electric power sector in Ethiopia. The creation of the EEA through parliamentary legislation bolsters the institution's credibility and is expected to positively influence investor and consumer confidence. The regulatory functions of the EEA and the obligations of the regulated utilities are explicitly delineated in the fundamental statute that establishes the Authority and associated regulations. This removes redundancies in the responsibilities of the regulator and the regulated utility. There appears to be duplication in the policy development responsibilities of the Ministry of Water, Irrigation and Electricity (MoWIE) and the Ethiopian Rural Energy Development and Promotion Centre (EREDPC) regarding their Energy Policy formulation activities. Despite EREDPC's responsibility for formulating Rural Energy Policy, the on-going rural-urban transition

necessitates that the energy policy addresses both urban and rural energy dynamics and their development.

2.7.7 Review of Evaluation of Ethiopian Public Procurement and Property Administration Proclamation No. 649/2009

The Ethiopian Federal Government Acquisition and Property Administration Proclamation No. 649/2009 delineate a comprehensive framework for the acquisition of commodities, services, and works, as well as the management of public property by federal government entities. The proclamation outlines stipulations on fixed assets, the disposal of public property, and public-private partnerships (PPPs), specifying the obligations and risks undertaken by private-sector concessionaires. Special provisions for national security or defence, and for inter-public body contracts, are also addressed, ensuring that procurement and property management promote economic efficiency. Proclamation No. 649/2009 serves as the principal legislation governing public procurement processes, grievance review systems, remedies, administration, and disposal of public assets. It is accompanied by a Procurement Directive that implements the concepts and regulations it contains. This Public Procurement system is mostly based on the 1994 UNCITRAL Model Law on Procurement of Goods, Construction, and Services, which includes a mandatory hierarchical complaints review structure. Public procurement entities have the obligatory authority to review grievances filed against their determinations in the first instance. The complaints review board and the courts serve as the corresponding higher tiers of review bodies.

2.7.8 Review of Ethiopian Trade Competition Proclamation No. 813/2013

On 21 March 2014, the Trade Competition and Consumer Protection Proclamation (No. 813/2013) became effective. The Proclamation applies to all enterprises providing services in Ethiopia. The Proclamation delineates the conditions under which an agreement is deemed unlawful, including the determination of a fixed price and the reduction of competition. Moreover, the law prohibits any actions that may jeopardise competitors or their commercial interests, including defamatory statements and improper comparisons of services. The Ethiopian Trade Competition and Consumer Protection Authority is the regulatory body responsible for enforcing laws governing trade practices and consumer protection. The law governs trade practices by safeguarding enterprises against anti-competitive and unfair activities to maintain a

competitive market environment. It additionally seeks to safeguard consumers against inequitable trade practices.

The Ethiopian government has enacted the Trade Competition and Consumer Protection Proclamation No. 813/2013 (hereinafter, the Proclamation) to safeguard consumers against deceptive market practices and harmful goods and services. The legislation aims to safeguard customers by prohibiting the distribution of goods and services that may negatively impact health and safety, while assuring their appropriateness for human use. It also endeavours to establish an environment in which consumers receive goods and services commensurate with the price they pay. Consequently, section three of the proclamation is devoted to consumer protection and the distribution of products and services. According to Article 14 of the declaration, consumers have numerous rights. Consumers have the right to receive sufficient and clear information or clarification regarding the quality and types of goods or services they acquire. They possess the right to independently acquire goods or services without obligation and to be treated with humility and respect, free from any mistreatment by the businessperson. Furthermore, customers may assert claims for compensation or associated rights for any damages sustained from the acquisition or utilisation of goods or services. Compensation and associated rights may be asserted against those engaged in the provision of products or services, including manufacturers, importers, wholesalers, retailers, or others involved. These parties are collectively and individually responsible for damages resulting from their products.

The proclamation safeguards consumers by imposing several obligations on the entrepreneur. The entrepreneur must exhibit the pricing of goods and services in compliance with Article 15 of the proclamation. The businessperson is also responsible for affixing labels on the things he sells on a separate sheet of paper. According to Article 16 of the proclamation, the label must specify the product name, country of manufacture or origin, quantity and quality of the product, safety precautions for use, manufacturing and expiration dates, and the addresses of the manufacturer, packer, and importer, among other details. Additional responsibilities of the businessperson encompass issuing receipts, prominently displaying the trade name, and abstaining from disseminating misleading or deceptive advertisements.

The proclamation establishes entities with regulatory authority to uphold consumer rights, enforce commercial obligations, and implement further rules. Consequently, there are three primary organs. The Ethiopian Trade Competition and Consumers Protection Authority is an

autonomous federal government entity with its own legal personality. The authority possesses the power to implement measures to enhance public awareness regarding the proclamation's provisions, declare goods prohibited by the government or internationally, prohibit advertisements for goods or services that contravene public health and safety standards, safeguard consumers against unfair trade practices, and establish procedures for resolving disputes between traders and consumers. The authority is also empowered to investigate the aforementioned matters, initiate actions, and subsequently issue decisions through its adjudicative benches. The second entity is the Federal Trade Competition and Consumer Protection Appellate Tribunal, which is empowered to hear appeals from the Authority's or its adjudicative panels' judgments. The third entity is the Regional Consumer Protection Judicial Organ and Appellate Tribunal. Article 34 of the proclamation permits regions to create consumer protection judicial bodies and appellate tribunals within their jurisdictions.

Table 4 Summary of Ethiopian Laws and Regulations Pertinent to Sustainable Supply Chain Practice

Proclamations	Implications for Manufacturing Industries
Environmental Impact Assessment Proclamation No. 299/2002	This proclamation establishes an essential regulatory framework to ensure that manufacturing firms operate in an environmentally responsible manner.
Ethiopian Labour Law Proclamation 1156/2019	Given the essential role of employees in the sustainability model, this proclamation is a fundamental labour regulation in Ethiopia, and understanding its applicability is crucial for manufacturing industries. It defines clear standards to ensure fair compensation and promotes harmonious employment interactions.
Ethiopia Investment Proclamation No. 1180/2020	The Proclamation pertains to several issues, including the scope of investments, the rights and obligations of investors, tax incentives, and the institutional framework for investment regulation. These are also the factors that need to be included in the sustainability supply chain management.
Environmental Pollution Control Proclamation No. 300/2002	The environment is a primary factor in supply chain sustainability; hence, this declaration outlines comprehensive requirements for pollution control and prevention, including the use of clean technologies.
Ethiopian Wildlife Development, Conservation, and Utilisation Proclamation No. 541/2007	Certain manufacturing companies in Ethiopia are located near areas designated for wildlife conservation. This instigates the necessity for proclamation to preserve wildlife.
Ethiopian Renewable Energy Development Proclamation No. 810/2013	The Proclamation outlines regulations on land use for electricity generation, transmission, and distribution, as well as on energy efficiency and conservation, which have implications for the sustainability of the supply chain in manufacturing industries.

Evaluation of Ethiopian Public Procurement and Property Administration Proclamation No. 649/2009	This has direct implications for sustainable supply chain operations of manufacturing industries as it provides a comprehensive framework for the procurement of goods, services, and works. It serves as the primary legislation for public procurement, grievance processes, and asset disposal, supplemented by a procurement directive.
Ethiopian Trade Competition Proclamation No. 813/2013	The Proclamation applies to all firms offering services, and it directly relates to the imposition of a set price and the suppression of competition. Furthermore, the law forbids any behaviour, such as making false comparisons between services or making defamatory remarks that could endanger rivals or their business interests.

2.8 Theoretical and Contextual Research Gaps

Research on sustainable supply chain management has primarily focused on developed and emerging economies such as China, India, various European nations, and the United States (Baliga *et al.*, 2019). These investigations have greatly enhanced our understanding of the factors promoting or hindering SSCM implementation, as well as its outcomes. However, the conclusions drawn from these studies may not be relevant to Ethiopia due to variances in institutional settings, regulatory landscapes, industrial growth, supply chain configurations, and the availability of resources.

In Ethiopia, there is a lack of extensive empirical research on SSCM, especially within the manufacturing sector (Balda & Singh, 2022). Most previous studies have concentrated on specific sustainability aspects or individual organizational functions instead of taking a holistic approach that integrates social, environmental, and economic factors. As a result, there is a gap in empirical evidence regarding the extent of SSCM implementation, the determinants affecting its adoption, its effects on organizational performance, and the suitable performance measurement frameworks for manufacturing industries in Ethiopia.

Sustainable Supply Chain Management has been thoroughly examined in developed nations and prominent emerging markets in Asia, such as China and India. However, there is a lack of empirical research in Sub-Saharan Africa. In Ethiopia, the manufacturing sector, especially medium- to large sized manufacturing firms and specialized industrial parks, is crucial to the country's economic development strategy. Yet, industrialization in this region occurs within

distinct socio-economic and institutional frameworks. One key characteristic of Ethiopia's manufacturing landscape is its dual-market focus. Export-driven manufacturing companies are integrated into global value chains, which mean they must comply with strict international buyer standards, meet global customer expectations, and adhere to demanding Environmental Management System (EMS) protocols. In contrast, firms targeting the domestic market deal with less pressure from stakeholders and face fewer stringent local regulations. Additionally, manufacturing businesses in the area encounter common systemic issues, such as the high initial costs associated with adopting green technologies and significant gaps in technical expertise and training.

To evaluate SSCM performance in Ethiopia effectively, it is vital to consider how institutional pressures, market orientations, and resource limitations interact, based on the Triple E framework (Economic, Environmental, and Social sustainability). This research aims to fill this contextual void by thoroughly evaluating SSCM practices in Ethiopian manufacturing sectors and creating a tailored performance measurement framework to facilitate effective SSCM implementation. Moreover, developing a contextual research framework is crucial to connect global sustainability theories with the practical realities faced by Ethiopian industries.

2.9 Theoretical Framework Development

This section outlines the theoretical framework for this research, providing a detailed exploration of the conceptual and theoretical basis underlying the study through a literature review. The study utilised an extensive literature review to develop the theoretical or conceptual framework, which is also presented in this chapter.

As discussed in the background of this study, sustainability is centred around creating a sustainable society, where there is a balance between population growth, social well-being, financial requirements, the use of natural resources, and reducing pollution, also connecting the three main supply chain sustainability dimensions (or triple E): economic, environmental, and empowerment. Sustainability involves meeting our current needs while ensuring future generations can meet theirs. Moreover, sustainability encompasses three primary aspects: economic, environmental, and social (Utama & Abirfatin, 2023). Regarding sustainable supply chains in manufacturing firms, they are defined as the production of goods and services through processes and systems that are non-polluting, conserve energy and natural resources, are

economically viable, ensure safety and health for employees, communities, and consumers, and are socially and creatively rewarding for all workers. Therefore, this study connects sustainability with the well-known triple 'E' concept that emphasises Environment, Economic, and Empowerment as the foundational elements of sustainability (Rodriguez *et al.*, 2022). To this end, this study aims to develop a comprehensive framework that integrates sustainability practices across the entire supply chain of Ethiopian large and medium-sized manufacturing firms. To develop the theoretical framework for this study, the researcher conducted a literature review.

Figure 3 presents the theoretical framework that underpins the study.

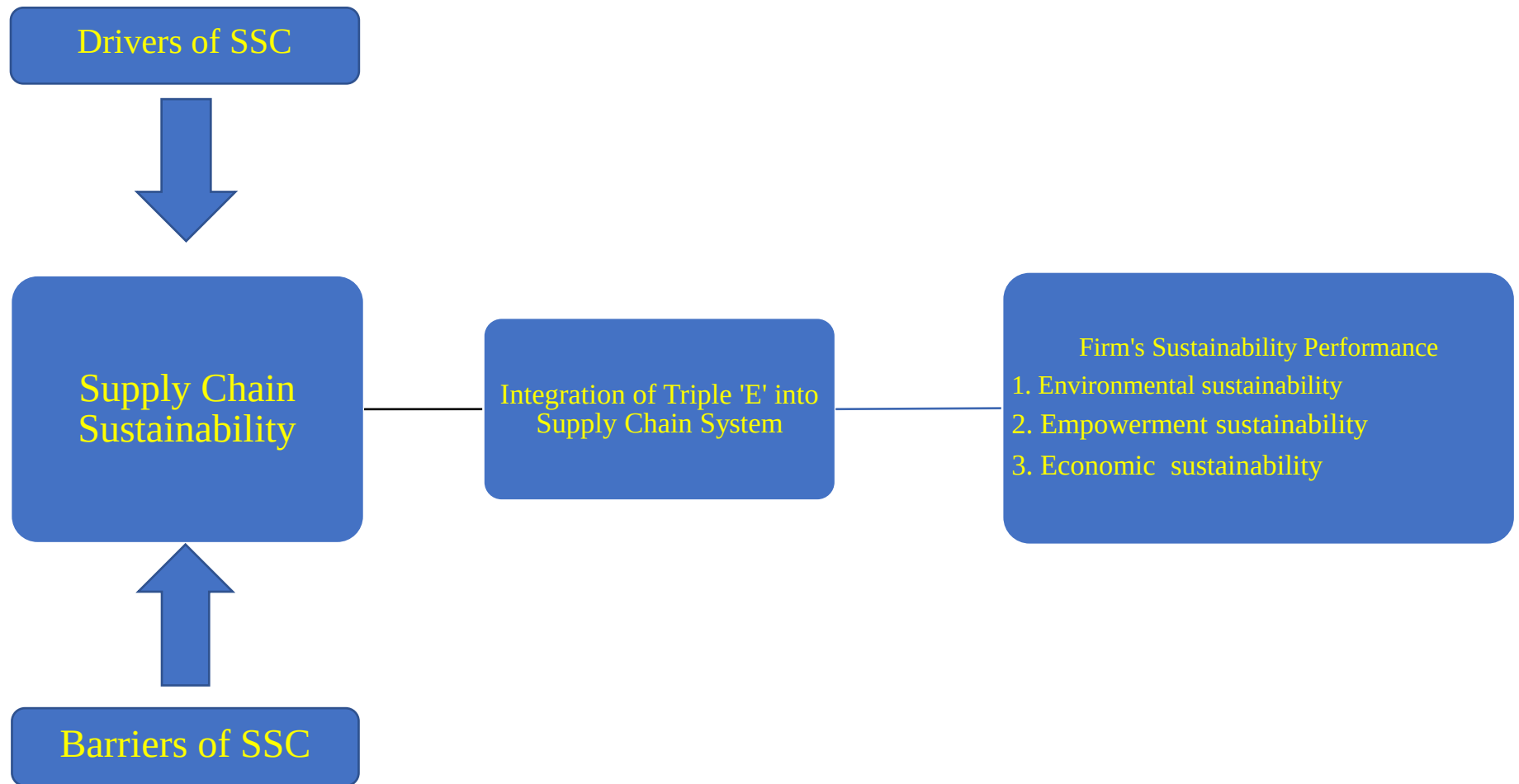


Figure 3 Sustainable Supply Chain Theoretical Framework (author's own development)

2.9.1 Description of the Theoretical Framework

2.9.2 Dimensions of Sustainable Supply Chain Management Practice

Sustainable Supply Chain Management (SSCM) is centred on developing and overseeing supply chain operations that lessen environmental impact, promote social responsibility, and ensure financial viability. In recent years, there has been a growing focus on the assessment of firms' sustainability through "triple bottom line", which aims to deliver insights into the three dimensions: economic, environmental, and social performance as a unified entity. When TBL is effectively understood and executed, it encourages organisations to evaluate the sustainability of their supply chain operations. Therefore, this study aims to assess the supply chain sustainability practices of the manufacturing industry through an in-depth analysis of the TBL. The environmental dimension of TBL highlights the necessity of sustainable and efficient resource use, minimising the consumption of raw materials and energy, lowering emissions, minimising the carbon footprint, enhancing manufacturing processes, and reducing waste. On the other hand, the social dimension involves the firm's capacity to implement Labour Rights and Fair Working Conditions, community engagement, and contribute positively to human capital and the community by providing safe working environment and equitable wages to employees, and by assisting local communities through efforts like sourcing from local suppliers, providing job opportunities to local inhabitants, and making charitable donations. Lastly, the economic dimension of TBL pertains to the effects of business activities on economic systems. It emphasises the organisation's capability to generate economic value for the national or international economy, supporting future generations in maintaining financial stability and growth. Through cost effectiveness and long-term sustainability, guaranteeing that the supply chain remains strong and capable of sustaining profits while addressing environmental and social objectives.

2.9.3 Sustainable Supply Chain Management Drivers and Barriers

Sustainable supply chain management drivers are pressures, triggers, and enablers that demand a firm implement sustainable practices. SSCM drivers motivate firms to adopt sustainability initiatives across the supply chain. On the other hand, sustainable supply chain barriers are internal and external obstacles that hinder the successful adoption of supply chain sustainability within firms ((Hsu *et al.*, 2013; Saeed and Kersten 2019). Therefore, the study will thoroughly assess and identify SSC drivers and barriers that prominently determine the successful implementation of sustainable supply chain practices in the Ethiopian manufacturing industry.

CHAPTER THREE RESEARCH METHODOLOGY

3.1 Introduction

Research methodology is the systematic design of research to ensure valid and trustworthy findings that adequately address the research's aim and objectives. More specifically, the overall plan of the study in terms of research philosophy, approach to developing theories, methodological choice, strategy, time horizon, and techniques is clearly specified (Saunders *et al.*, 2009). Moreover, it concerns the methodological techniques a researcher uses when designing a study to ensure accurate outcomes that meet the research's goals and objectives. This chapter presents a summary of the research techniques, methodological choices, research purpose, research philosophy, and research approach used in this study. To structure the methodology in a systematic manner, the 'research onion' framework (see Figure 1), developed by Saunders *et al.*, (2009), has been used comprehensively.

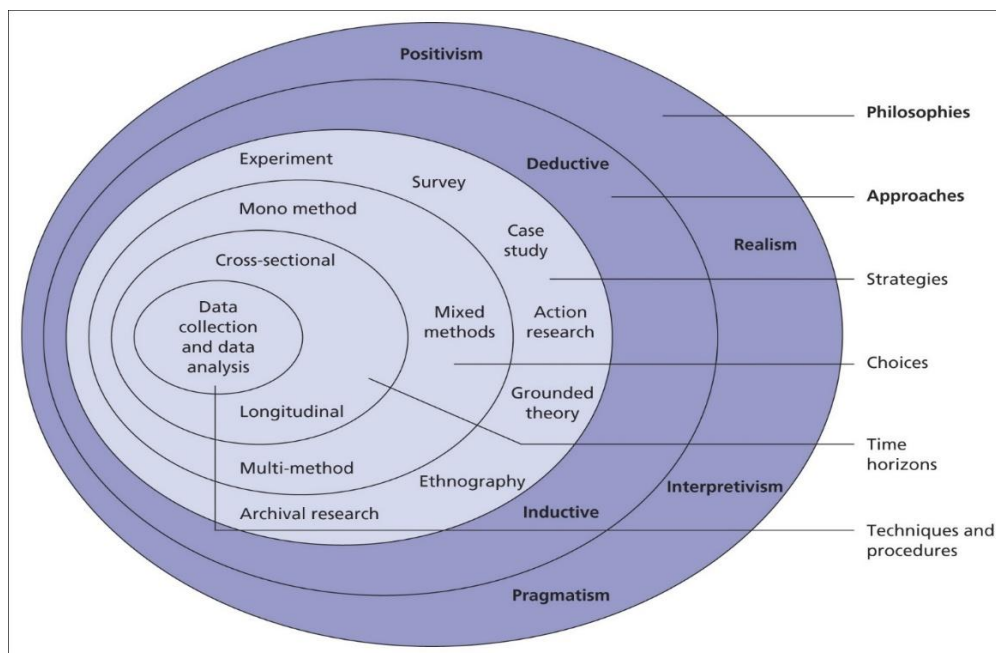


Figure 4 The Research Onion (Saunders *et al.*, 2009)

In this chapter, the study's plan is specified, with sections explaining the philosophy, approach to theory development, methodological choice, strategy, time horizon, and techniques appropriate to this study. Each section also briefly explains each layer of the research onion developed by (Saunders *et al.*, 2009).

3.2 Research Purpose

The purpose of this research is exploratory as it intends to understand the existing knowledge and explore factors affecting the Supply chain sustainability implementation in manufacturing industries in Ethiopia.

3.3 Research Philosophy

Research philosophy is the basis of any study as it labels the set of beliefs upon which the investigation is based. Research Philosophy refers to the set of beliefs concerning the nature of the reality being investigated. It is associated with assumptions, knowledge, and the nature of the study, and concerns the specific way in which knowledge is developed. This matter needs to be addressed because researchers may hold different assumptions about the nature of truth and knowledge, and philosophy helps us understand those assumptions. Furthermore, research philosophy concerns the sources, nature, and development of knowledge. In simple terms, research philosophy is the belief about how data on a phenomenon should be collected, analysed, and used.

This research employed a pragmatist research philosophy, which holds that the key determinants of the adopted philosophy are the research question, research aim, and objectives. The practice and performance of supply chain management are best explained by developing research questions with a clear objective. Pragmatism (doing what works) argues that the most important determinant of the research philosophy adopted is the research question, arguing that it is possible to work within both positivist and interpretivist positions. It applies a practical approach, integrating different perspectives to help collect and interpret data. Moreover, pragmatism provided a solid and adaptable philosophical basis for this research, allowing the researcher to investigate sustainable supply chain challenges through a problem-focused, mixed-methods, and context-aware approach. Additionally, Pragmatism allows the integration of both quantitative and qualitative data types, which helps generate practical, context-specific, and actionable solutions. For these reasons, pragmatism is well-suited for this study.

3.4 Research Approach

This research applied abductive approach with the dominance of deductive approach. As this study starts with existing theories such as Triple E, resource based view, stakeholder, develops research questions, collects data, and tests whether the theory is supported. Survey was used to assess sustainable supply chain management practices and their impact on a

firm's overall performance, considering environmental, social, and economic dimensions. Moreover, the deductive approach begins with the formulation of specific research questions; accordingly, this research seeks to test existing theories related to sustainable supply chains, their practices, and the relationships among them via its research questions. Additionally, the study incorporates clearly defined variables linked to the firm's overall sustainable supply chain practice and performance. Since the deductive method is particularly appropriate for quantitative analysis, this study also utilized a survey-based approach for data collection. Ultimately, the use of a deductive framework enables the generalization of the research findings as this study did similarly.

3.5 Methodological Choice

This research has adopted the 'mixed-method-simple' approach to achieve methodological triangulation, thereby enhancing the validity and reliability of the findings. A mixed-methods approach was chosen for this study because the study of sustainable supply chain involves addressing environmental, social, and economic aspects that demand both qualitative and quantitative data types, as applying one method alone is insufficient for such a wider concept. Therefore, this study has employed a survey as one of the quantitative methods to assess the level of sustainable supply chain practices implementation and its performance among Ethiopian manufacturing firms. Additionally, interviews with various qualitative methods were carried out to reap deeper understanding of the adoption process. Table 7 presents the tools used in this research and their groupings.

- A. Questionnaire-** A questionnaire was distributed to the managers of each selected firm to get responses on SSCM practice, pressure and performance. A five-point Likert scale quantitative data tool was used. The questions were close-ended questions with fixed response options and each response was assigned a numerical value to use the statistical methods
- B. Interview-** Interview was conducted with the supply chain department heads of the selected manufacturing firms, representatives of the Ethiopian Chamber of Commerce & Sectoral Associations, inhabitants living around the manufacturing industry, and the Labour union/trade union.
- C. Focused Group Discussion-** Given that the large and medium-sized Ethiopian manufacturing companies significantly influence society at large and particularly the local communities nearby, it is crucial to verify the sentiments of these residents against

the company's stated sustainable supply chain commitments. Therefore, focus group discussions were held with individuals living near these manufacturing facilities. The discussions aimed to gather insights from local residents on their expectations of the manufacturing industry regarding the environmental, community, and social aspects of a sustainable supply chain. It is anticipated that those living near manufacturing firms are particularly affected by the environmental disruptions these businesses cause, making them an important source of information on this topic. Hence, a focus group discussion was carried out with inhabitants living around the manufacturing industry through their representatives (from Lemi-kura and Akaki kaliti Districts of Addis Ababa). Representatives from labour unions also served as key direct addresses on sustainable supply chains, clarifying their relationships with manufacturing companies while expressing their opinions on how these firms should treat their internal employees. Industry Park Directors/experts from the selected areas of Addis Ababa, Hawassa, Adama, and Kilinto also provide essential insights, as they are directly involved in establishing manufacturing firms and offer whatever support these companies may require. Additionally, firm managers, through their representatives, representatives from the Ministry of Trade and Regional Integration, and academics from universities contribute to the information pool. The group discussion focused mainly on the environmental aspects of SSCM. All participants in the focus group discussion attended a three-day symposium (held at their premises in Addis Aaba, Hawassa, and Adama), where they contributed insights and shared their knowledge and expertise on effectively implementing sustainable supply chains in manufacturing companies for the benefit of both manufacturers and communities.

- D. Observation-** Observation on existing SSCM initiatives was conducted. This includes social responsibility activities undertaken by large and medium-sized manufacturing firms to provide a full picture of SSCM practice. Mainly, the social contributions (such as schools and health facilities, to mention a few) made by manufacturing firms were observed, along with their environmental protection practices and support for nearby communities.

3.6 Research Strategy

A survey involves the structured collection of data from a sizable population. Even though the term "survey" is frequently used to refer to the process of gathering data through

questionnaires, it also encompasses other methods such as structured observation and structured interviews. Therefore, the survey research strategy is appropriate for this study because it allows the collection of empirical data from a large sample of manufacturing firms operating in the Ethiopian economy. This research strategy helps the researcher obtain first-hand data on the assessment of the practice, pressure, and performance of sustainable supply chain management among large and medium manufacturing firms in Ethiopia.

This study adopted a sequential explanatory mixed-methods research strategy quantitative to qualitative (QUAN → qua) within a pragmatist research philosophy. The order of the methods was determined by the research objectives.

The quantitative phase was conducted first because the primary objectives required the collection of numerical data from manufacturing firms. Specifically, Objective 1 sought to assess the extent of sustainable supply chain management practices and identify key social, environmental, and economic sustainability indicators through a survey, complemented by a literature review. Objective 2 examined the enablers and barriers influencing SSCM implementation, while Objective 3 investigated the determinants of SSCM practices on firm performance using quantitative statistical analyses. These objectives required a quantitative approach to provide empirical evidence on the prevalence of SSCM practices and the relationships among the study variables.

The qualitative phase followed the quantitative analysis to explain and enrich the survey findings. Interviews and focus group discussions were conducted to gain a deeper understanding of the quantitative results, particularly regarding the reasons behind the identified barriers, enablers, and performance outcomes. The qualitative findings also informed the development of the proposed SSCM performance measurement framework (Objective 4) and provided expert insights for its verification and validation (Objective 5).

The integration of the quantitative and qualitative strands occurred during the interpretation and framework development stages. Quantitative findings identified the key empirical relationships and significant factors, while qualitative evidence explained these findings, refined the proposed framework, and strengthened its practical relevance for Ethiopian manufacturing industries. Thus, the sequence of the mixed-methods design was directly aligned with the research objectives and ensured that each method contributed to addressing specific aspects of the research problem.

A survey was conducted by first developing a questionnaire and testing it with a small group. After receiving feedback from selected experts during the pilot test, several enhancements

were made to the questionnaire. Approval for data collection was obtained from supervisors and from Liverpool John Moores University [UREC reference: 23/ENR/005] to proceed. Research assistants were hired and given training, after which data collection began. At first, the questionnaire was distributed in print. However, the response rate was unexpectedly low, leading to longer collection times than anticipated. Consequently, data collection was restarted using the Kobo Toolbox, a platform for data management and collection. This transition modernised both the data collection process and entry, providing a user-friendly experience for respondents. Participants received a friendly push to complete the questionnaire via email and phone. As a result, 86 manufacturing firms took part in the survey.

Analysis Sequence and Justification

The data analysis was conducted in a sequence that was guided by the research objectives and the overall aim of the study, which was to develop and validate a sustainable supply chain management (SSCM) performance measurement framework for Ethiopian manufacturing industries. The sequence was designed to move from understanding the current state of SSCM practices to identifying important factors associated with their adoption and, subsequently, using the evidence to develop and validate the proposed framework.

The analysis first used descriptive statistics to summarize the characteristics of the participating firms and to assess the extent to which social, environmental, and economic SSCM practices were being adopted. This stage provided an overview of the current state of SSCM implementation in the manufacturing sector and established a baseline for addressing the objective concerned with existing sustainability practices.

The descriptive analysis was followed by logistic regression (Logit) analysis. The Logit model was used to identify factors that were significantly associated with the adoption of SSCM practices. While descriptive statistics provide information about the distribution and prevalence of observed practices, they do not establish which factors are statistically associated with SSCM adoption. The Logit analysis therefore provided further evidence on the factors that may facilitate or constrain the implementation of SSCM practices. Where relevant, the regression results were also considered alongside the findings on firm

performance to examine the relationship between sustainability-related practices and financial performance.

The quantitative findings were then considered together with the qualitative evidence and the relevant literature. The qualitative findings provided additional explanations for the patterns observed in the quantitative analysis, particularly in relation to the barriers, drivers, and contextual conditions affecting SSCM implementation. Bringing these sources of evidence together provided a broader empirical basis for identifying the key elements to be incorporated into the proposed performance measurement framework.

DMAIC was subsequently used as a structured methodology for developing and improving the framework. It was not used as a statistical analysis technique; rather, it provided a systematic approach for translating the empirical findings into a practical framework. In the **Define** stage, the main sustainability problems and challenges identified by the study were clarified. The **Measure** stage focused on identifying appropriate sustainability performance indicators. The **Analyze** stage brought together the findings from the descriptive, Logit, and qualitative analyses to determine the main areas requiring attention. The **Improve** stage was used to identify appropriate measures and interventions for improving SSCM performance. Finally, the **Control** stage incorporated mechanisms for monitoring performance and supporting continuous improvement.

Following the development of the framework, its relevance and practical applicability were assessed through expert evaluation. This process provided an opportunity to obtain feedback from knowledgeable practitioners and academics and to determine whether the proposed framework was appropriate for the Ethiopian manufacturing context. The framework was subsequently refined based on the evaluation and validated for its relevance, practicality, and applicability.

Accordingly, the overall analysis and framework development process can be summarized as follows:

The sequence is: - Descriptive statistics → Logistic regression → Qualitative interpretation → Framework development uses DMAIC → Framework verification/validation.

3.7 Time Horizon

The time horizon merely specifies the number of time points (see Table 5) at which the study intends to collect data. The cross-sectional and longitudinal time horizons are the two choices, with this study employing the cross-sectional approach. This research adopts a cross-sectional time horizon, as it provides a quick view and assessment of sustainable supply chain practices, pressures, and performance, with rapid identification and assessment of barriers and enablers to implementation within large and medium manufacturing firms in Ethiopia at a particular moment. This approach also highlights the present degree of sustainable supply chain implementation and its effectiveness.

Table 5 Time Horizon

Time horizons	Description
Cross-sectional	The study of a particular phenomenon at a particular time, i.e., a ‘snapshot’.
Longitudinal study	The study of a particular phenomenon (or phenomena) over an extended period of time.

3.8 Data Collection

3.8.1 The Data Collection Tools and Process

Given the variety of manufacturing sectors in terms of size and type, it is expected that there will be variations in how well sustainability practices are implemented, the attention they receive, and the pressure placed on them. Accordingly, this study used a purposive sampling technique. Purposive sampling is used when the researcher selects a ‘typical’ sample based on specialist knowledge or selection criteria (Palinkas *et al.*, 2016). Purposive sampling is a commonly employed nonprobability method that plays a crucial role in qualitative and mixed-methods research due to its emphasis on in-depth, contextual understanding. This technique involves a deliberate selection of particular units or direct addresses for the intended purpose (such as individuals, cases, or events), based on their significance to the research objectives and question, allows researchers to gain a thoughtful understanding of complex phenomena. Purposive sampling provides benefits such as adaptability and the capacity to focus on information-rich cases (Given, 2012). Therefore, the study specifically targeted the major manufacturing industries and industrial parks located in the major Ethiopian cities of Addis Ababa, Hawassa, and Adama. The study surveyed 86 manufacturing firms with an average operating history of 11 years (mean: 11.709 years). This implies that they were established at a time when sustainable supply chain management had

already gained momentum globally, with no alternatives other than adopting sustainable supply chain practices. In addition, the manufacturing firms in the industry parks are export-oriented; hence, they have no option but to implement sustainable supply chain practices to enter the international market.

To collect data, a questionnaire (see Appendix 1) was developed and pilot tested. Following the pilot test among selected experts, some improvements were made. A formal approval of the data collection by Liverpool John Moores University [UREC reference: 23/ENR/005] was obtained to commence data collection. To collect data, research assistants were recruited and provided with orientation, and data collection commenced. Initially, the questionnaire was distributed in print. However, the response rate was very slow and took longer than expected. Therefore, data collection was restarted using the KoboToolbox, a data collection and management platform. This aligned data collection and entry, and created a more user-friendly experience for respondents. Respondents were given gentle reminders to complete the questionnaire via email and phone. Consequently, 86 manufacturing companies participated in the survey.

Structured interview questions were developed (see Appendix 1), and interviews were conducted with Industry Park Experts, manufacturing firm managers, and representatives of the Ethiopian Chamber of Commerce. The interviewees were intentionally chosen based on their expertise and relevance to sustainable supply chain management; for example, the company managers selected for the interviews have worked closely in their company's supply chain department. Directors (experts) from Industry Parks, who are responsible for closely supporting and monitoring the manufacturing firms within the industry parks, were also included. Additionally, representatives from the chamber of commerce, an organisation that oversees the overall performance and compliance of manufacturing firms, were part of the interviews. The interviewees were located in the designated study areas, which include Addis Ababa, Hawassa, and Adama. The interviews took place in person.

Additionally, observation was also employed as a data collection method. The observations were mainly made on existing SSCM initiatives. The researcher observed the manufacturing firms' investment in community well-being, schools, health facilities, and youth sports clubs, as well as in water and hygiene, to determine whether the manufacturing firms provided any such support to local residents.

3.8.2 Methods of Data Collection

- A. Questionnaire** was distributed to the CEO/managers/representatives of the manufacturing industries to get responses on SSCM practice, pressure and performance.
- B. Interviews** were conducted with supply chain department heads of the selected manufacturing firms, representatives of the Ethiopian Chamber of Commerce and Sectoral Associations, and labour unions/ trade unions. Interviews were also conducted with inhabitants living near those manufacturing industries. The focus of the interviews with the inhabitants was mainly to explore the social and environmental aspects of SSCM.
- C. Observations** have been made on existing SSCM initiatives. This includes social responsibility activities to get a full picture of SSCM practice. The observation focuses mainly on common practices on the ground regarding the environmental and social elements of the sustainable supply chain, and on whether manufacturing firms have actually adopted them. To conduct the observation, key performance indicators for environmental and social sustainability were used. Among the key performance indicators, the firms' contributions to the overall well-being of the community and its employees, and to the preservation of the natural environment and labour conditions, as well as to employee engagement, corporate social responsibility and community relations, energy efficiency, water management, and waste management in particular, were assessed and observed.

3.8.1 Sampling Techniques and Sampling Size Selection

According to the Ethiopian Investment Commission, the classification of medium and large manufacturing industries is based on: number of employees, annual production capacity '000 Birr, capacity utilised currently (%), proportion of production for the Local market (%) and Export (%), and Input Import component (raw materials) (%).

Given the variety of manufacturing sectors in terms of size and type, it is expected that there will be variations in how well sustainability practices are implemented, how much attention they receive, and how much pressure is placed on them. Accordingly, this study has used a multi-stage sampling, first it has purposively selected medium and large manufacturing industries in terms of their size, number of employees, annual production capacity '000 Birr, capacity utilised currently (%), proportion of production for Local market (%) and Export (%), and Input Import component (raw materials) (%). To enable this, industry parks in

Ethiopia were mainly targeted. In Ethiopia, the industry parks are categorised into three: Apparel and Textile, Pharmaceuticals, and Multi-sectoral industries. The second step in the multi-stage sampling is simple random sampling, which was used to determine the final sample from the list of medium- and large-sized manufacturing industries.

3.8.2 Study Area Selection and Justification

The study targets medium and large manufacturing industries in Ethiopia. To enable precise target identification, industrial parks in Ethiopia are a dominant source of data. The Industrial Parks Development Corporation (IPDC) was established in 2014 as one of the public enterprises. inspired by the full support of the government, IPDC is becoming an engine of rapid industrialisation that nurtures manufacturing industries, accelerates economic transformation, promotes export, creates employment opportunities, promotes and attracts both domestic and foreign investors; thereby, the country's development will achieve the middle-income status and a leading green manufacturing hub in Africa by 2030 (Ababa, 2025). In Ethiopia, there are twelve (12) Industrial Parks grouped into three (3) different sectors, namely, Apparel & Textile, Multi-sectoral, and Pharmaceutical.



Figure 5 Industry Parks Location (Source IPDC, 2024)

Table 6 presents the selected Ethiopian Industrial Parks and their Category, Location and Status. A further detail about why these have been selected is discussed after the table.

Table 6 Selected Ethiopian Industrial Parks and their Category, Location and Status

Category	Location	Status
Multi-sectoral Industrial Parks	Addis Industry Village	Functional
	Adama	Functional
	Bole Lemi kura	Functional
Pharmaceutical Industrial Park	Kilinto	Functional
Apparel and Textile Industrial Parks	Hawassa	Functional

1. Addis Ababa

Addis Ababa has a significant concentration of medium and large manufacturing industries, making it a deliberate choice for the study. In Addis Ababa, there are 210 Medium and Large industries, and the only pharmaceutical industrial park, Kilinto IP, is also located there.

2. Adama Industrial Park

Adama Industrial Park (120 hectares) is located in Adama, around 74 km from Addis Ababa. It started operations in October 2018, with 19 factory sheds already rented to investors from Japan, China, and Ethiopia. It specialises in Machinery, Apparel, and Garments, with 100% exportable products, and the sheds are fully occupied. Adama Industrial Park is selected because it is the largest multi-sectoral manufacturing industrial park in Ethiopia.

3. Kilinto Industrial Park

Kilinto (279 hectares) is located in Addis Ababa. The park started operations in 2019. It is currently being developed in collaboration with the World Bank Group. Specialising in Pharmaceuticals, Kilinto Pharmaceuticals is the only Pharmaceutical Industrial Park in Ethiopia.

4. Hawassa Industrial Park

Hawassa Industrial Park (140 hectares) is in Hawassa city, located around 275 km from Addis Ababa. It started operations in January 2016, with 52 factory sheds already rented to investors from the USA, India, China, Sri Lanka, France, Belgium, Indonesia, South Africa, and Ethiopia. It specialises in Apparel, Textiles, and Garments, 100% exportable products, and sheds are fully occupied. It has access to a domestic airport. Hawassa Industrial Park is the largest of all Ethiopian Industrial Parks in the Apparel and Textile category.

3.8.3 Sample Size

The study specifically targets the medium- and large-scale manufacturing industries and industry parks in Addis Ababa, Hawassa, Kilinto, and Adama, Ethiopia. Therefore, the final sample comprises 163 firms (only 86 participated in the survey) from a total population of 281 firms. This considers a sampling formula for a finite population with 5% error margin and 95% confidence.

3.9 Data Analysis Structure

With due consideration to the Triple-E model (Triple Bottom Line), the analysis structure for each research objective (RO) is briefly stated as follows.

RO1. Investigate the practice of the SSCM in the manufacturing industry

This objective focuses on the assessment of sustainable supply chain management practice; accordingly, a qualitative approach using literature review and descriptive statistical analysis has been employed to investigate this objective. For the rating scales within these five-point scales, the interval for breaking the range distance in measuring the variables is calculated by the formula adopted from Vichea (2005), see equation (1).

$$\frac{(n-1)}{n} = \frac{(5-1)}{5} = \frac{4}{5} = 0.8 \quad (1)$$

Meaning of the mean value of the variables falling within

- ✓ 4.20-5.00 are going to be taken as strong agreement
- ✓ 3.40-4.19 are going to be taken as agreement
- ✓ 2.60-3.39 are going to be taken as indifferent
- ✓ 1.80-2.59 are going to be taken as disagreement
- ✓ 1.00-1.79 are going to be taken strong disagreement

The classification of mean values into agreement levels is based on dividing the total range of the five-point Likert scale into equal intervals using the equation 1. This result (0.8) represents the width of each category interval. Starting from the minimum value of 1.00, each subsequent category is constructed by adding 0.8. Therefore, any computed mean value of a variable is interpreted based on the interval in which it falls. This approach ensures a consistent and systematic interpretation of responses measured on a five-point Likert scale.

The quantitative data analysis was conducted in a logical sequence aligned with the research objectives. Descriptive statistics were used to summarize the characteristics of the participating manufacturing firms and describe the extent of sustainable supply chain

management practices. This provided a baseline understanding of the current state of SSCM implementation.

RO2. Identification of factors (enablers and barriers) affecting SSC practice/implementation in the manufacturing industry.

To investigate and find the factors affecting sustainable supply chain practice, factor analysis has been employed. The goal of factor analysis is to explain the covariance or correlations among variables, thereby reducing the data to a smaller number of components and identifying the main factors. Factor analysis is a method for investigating whether a number of variables of interest, $Y_1, Y_2, \dots, Y_l$, are linearly related to a smaller number of unobservable factors, $F_1, F_2, \dots, F_k$.

(Decoster & Hall, 1998), defines two types of factor analysis:

- First exploratory factor analysis (EFA) attempts to discover the nature of the constructs influencing a set of responses. It is used to uncover the underlying structure of a large set of variables.
- The second type is confirmatory factor analysis (CFA), which tests whether a specified set of constructs is influencing responses in a predicted way and determines conformity to what is expected on the basis of pre-established theory.

Accordingly, this study has employed exploratory factor analysis (EFA) to help data reduction and remove redundancy or duplication from a set of correlated variables. Taking the insight from the mathematical model of (Joliffe & Morgan, 1992), this study adopts the following model for exploratory factor analysis, respectively;

$$\text{The EFA Model is } Y = X\beta + E \quad (2)$$

Where

Y is a matrix of measured variables

X is a matrix of common factors

β is a matrix of weights (factor loadings)

E is a matrix of unique factors, error variation

Exploratory factor analysis was performed to reduce the data to a smaller number of components and identify the main factors. The validated factors were subsequently used in the inferential analysis.

RO3. Investigate the determinants of SSC practices on a firm's performance

To investigate determinants of sustainable supply chain management performance, both the estimation technique ordinary least squares (OLS) and the logit model have been employed

A. Ordinary Least Squares

The estimation technique (OLS) minimises the residual sum of squares when estimating the parameters. The general model looks like:

$$Y = X\beta \quad (3)$$

Where:

Y is the outcome/dependent variable;

X-the vector of independent variables; and

β -is the vector of the parameters, including the constant term.

Working Definition of the Variables

Dependent variable:

- **Gross profit:** Continuous variables represent the amount of profit earned by the firms.

Independent Variable

- **Environmental Policy-** dummy variable measured in terms of the existence of the policy (1=yes, 0 otherwise).
- **Environmental management system certification-** dummy variable measured in terms of the existence of environmental management certification (1=yes, 0 otherwise).
- **Corporate social responsibility policy:** dummy variable measured in terms of the existence of corporate social responsibility policy (1=yes, 0 otherwise).
- **Health and safety standard certification:** dummy variable measured in terms of the existence of health and safety standard certification (1=yes, 0 otherwise).
- **Energy audit:** dummy variable measured in terms of the existence of an energy audit periodically (1=yes, 0 otherwise).
- **Waste audit:** dummy variable measured in terms of the existence of a waste audit periodically (1=yes, 0 otherwise).

Ordinary least squares regression was employed to examine the relationship between SSCM practices and firms' financial performance, measured by gross profit. OLS was appropriate because gross profit is a continuous dependent variable, enabling the study to estimate the magnitude and direction of the effects of SSCM practices on financial performance.

B. Logit Model

Logit and probit models are appropriate for analysing the relationship between dichotomous outcome variables and other sets of independent variables (Wooldridge, 2002). The general model specification looks like:

$$P(Y = 1|X_i) = \frac{e^{X_i\beta}}{1 + e^{X_i\beta}} \quad (4)$$

Where:

Y is the discrete choice outcome variable.

X_i- the set of explanatory variables.

β- the vector of parameters.

Working Definition of the Variables

Dependent variable

- **International Environmental certification:** Dummy variable measured in terms of the existence of environmental management certification (1=yes, 0 otherwise).

Independent variables

- **Market share:** Continuous variable measured in terms of market share improvement of the last two years
- **Number of Export products:** Continuous variable measured in terms of the number of export products
- **Export destination country:** Continuous variable measured in terms of the number of export destination countries
- **Sustainability data sharing:** Dummy variable measured in terms of the existence of a sustainability data sharing protocol (1=yes, 0 otherwise).
- **Public target setting:** Dummy variable measured in terms of the existence of environmental public target setting (1=yes, 0 otherwise).

Dependent variable

- **Corporate social responsibility policy:** Dummy variable measured in terms of the existence of corporate social responsibility policy (1=yes, 0 otherwise).

Independent variables

- **Trade union:** Dummy variable measured in terms of the existence of trade union (1=yes, 0 otherwise).

- **Health insurance:** Dummy variable measured in terms of the existence of health insurance for employees (1=yes, 0 otherwise).
- **Employee appraisal:** Dummy variable measured in terms of the existence of regular employees' appraisal (1=yes, 0 otherwise).
- **Local sourcing:** Continuous variable measured in terms of the share of local sourcing from the overall company sourcing
- **Disable employee:** Dummy variable measured in terms of the existence of rules and regulations suitable for disabled employees

Binary logistic regression (Logit) was used to analyse the determinants of Environmental Management System certification and Corporate Social Responsibility adoption. These variables are dichotomous making logistic regression the appropriate analytical technique for estimating the probability of these outcomes.

To conclude, the quantitative findings informed the subsequent qualitative phase. Interviews and focus group discussions were conducted to explain the statistical results, particularly the reasons underlying the observed relationships and the barriers and enablers of SSCM implementation. The integrated findings from both phases informed the development of the SSCM performance measurement framework using the DMAIC methodology, which was subsequently verified and validated through expert evaluation.

3.10 Framework Development and Approaches

The lack of a standardised framework for evaluating and measuring sustainable supply chain management performance in Ethiopian manufacturing industries presents significant challenges, particularly in developing measurement tools suited to the Ethiopian context. There is a scarcity of research that integrates the social, environmental, and economic dimensions within the TBL framework, especially from a supply chain perspective. Additionally, establishing a clear causal link between implementing sustainable practices and economic performance remains a challenge. There is also uncertainty about the relationship between SSCM practices and performance improvements in manufacturing firms in Ethiopia. Furthermore, there is limited empirical research specifically addressing sustainability in Ethiopian manufacturing supply chains. To address these gaps, this study has developed and validated a framework (depicted in Chapter 6) for evaluating and measuring sustainable supply chain management performance. The framework is expected to enable the large and

medium-sized Ethiopian manufacturing firms to adopt sustainable supply chain practices and measure their performance.

DMAIC, as a framework approach, is a structured, five-phase, data-driven problem-solving approach used to improve, enhance, and stabilise business processes. DMAIC stands for Define, Measure, Analyse, Improve, and Control, and is widely used to optimise processes and drive continuous improvement across different sectors. A DMAIC-based method can be effectively utilised to structure the sustainable supply chain for sustainable manufacturing, incorporating metrics to assess the economic, environmental, and social sustainability performance of a manufacturing industry (Rodriguez *et al.*, 2022). Moreover, DMAIC provides a structured framework for organisations to identify, measure, analyse, improve, and control their sustainable supply chain processes, thereby increasing efficiency, reducing waste, and improving overall organisational performance. The DMAIC approach is suitable for developing a framework to enhance overall sustainable supply chain performance (Rodriguez *et al.*, 2022). Hence, this study used the DMAIC approach to develop a comprehensive framework. The following discussion demonstrates how the framework was developed through the DMAIC method. The five phases of DMAIC approach define, measure, analyse, improve, and control that were used to develop the framework are presented below.

A. DMAIC Approach

Phase 1- Define

This phase helps to understand and assess sustainable supply chain practices within large and medium manufacturing industries in Ethiopia. Understanding and defining the problem in the sustainable supply chain enables improvements to existing problems and fixes implementation issues in manufacturing industries.

Phase 2- Measure

Measurement enables the establishment of metrics to evaluate sustainable supply chain performance. Measurement provides clear key performance indicators to determine current performance. This phase also includes identifying activities that contribute to the challenges.

Phase 3- Analyse

The root causes that trigger a sustainability problem, and the degree of significance, need to be identified and analysed. Comparing the existing performance to the sustainability goal is the basis of the analysis.

Phase 4- Improve

Addressing and solving the root-cause challenges of sustainability and implementing solutions are key features of this phase. To this end, the improvement stage tests and implements solutions.

Phase 5- Control

Implementing, maintaining and institutionalising sustainability solutions in the manufacturing industries are the main features of this phase.

3.10.1 Framework Verification

The developed framework has been checked to ensure it has been developed correctly and is appropriate and suitable for the Ethiopian manufacturing industry's context. Framework verification was conducted through a Focus Group Discussion (FGD). The FGD has included a group of relevant stakeholders, including inhabitants living around the manufacturing industry through their representatives (from Lemi-kura and Akaki kaliti Districts of Addis Ababa), Representatives from labour unions, experts with due knowledge and experience in the subject, such as Industry Park Directors (IPD)/ experts from the selected areas of Addis Ababa, Hawassa, Adama, and Kilinto, firm managers through their representatives, and academics from universities, and representatives from the Ministry of Trade and regional integration.

Table 7 Criteria for sample selection for the FGD

FGD Participants	Participant's Address	Selection Criteria
Local community/inhabitants representatives	Lemi-kura and Akaki kaliti Districts) Addis Ababa	• They are directly affected by the establishment of the manufacturing firms in different ways.
Representatives from labour Unions	Addis Ababa	• They are established to safeguard the safety of employees

Industry Park Directors/Experts	Addis Ababa, Hawassa, Adama, and Kilinto	• Highly involved in the establishment of the manufacturing firms. • Highly involved in the on-going operations of the manufacturing firms • Controls whether the manufacturing firms are fulfilling the agreed terms while commencing their operations
Firm managers' Representatives	Addis Ababa, Hawassa, Adama, and Kilinto	• They are the major ones who have due knowledge about sustainable supply chain practices implementations in their firms.
Academics from Universities	Addis Ababa and Mekelle University	• They have adequate Knowledge about the sustainable supply chain subject area.
Representatives from the Ministry of Trade and Regional Integration	Addis Ababa	• They represent the regulatory body. • They have adequate and practical knowledge about the overall Sustainability strategies and directions of the country.

3.10.2 Framework Validation

The developed framework was validated (chapter 6) using an empirical method based on phenomena observed and measured through a survey and structured interviews. Hence, this study has applied an empirical method to develop and validate the framework. Data collection using both questionnaires and structured interviews was used to validate the framework in this study.

In summary, this research utilised an extensive methodological approach based on Saunders *et al.*, (2009), "Research Onion" framework to methodically examine sustainable supply chain management (SSCM) practices within Ethiopian manufacturing sectors. With an exploratory aim and a pragmatist philosophy, it employed an abductive method with a dominant deductive aspect to combine theory formation and empirical validation. A mixed-method approach was employed, integrating quantitative (surveys) and qualitative (interviews, group discussions, observations, and document examination) methods. Data were collected cross-sectionally from medium- and large-sized manufacturing companies in Addis Ababa, Kilinto, Adama, and Hawassa using multi-stage sampling, yielding 86 valid

responses. Analytical methods involved descriptive statistics, exploratory factor analysis to pinpoint primary enablers and obstacles, and regression models (OLS and Logit) to ascertain the factors influencing SSCM performance. Additionally, a DMAIC (Define–Measure–Analyse–Improve–Control) framework was created, confirmed through discussions with expert focus groups, and empirically validated to guarantee its contextual relevance and practical applicability to the manufacturing sector in Ethiopia.

CHAPTER FOUR

DATA COLLECTION AND ANALYSIS

4.1 Introduction

This research employed a pragmatist research philosophy, as the practice and performance of supply chain management is best explained by developing research questions with clear objectives. This research applied an abductive approach, with a strong emphasis on deductive reasoning. The data were gathered to evaluate and test a set of sustainable supply chain practices and their connection to the overall performance of firms, with consideration of environmental, empowerment (social), and economic dimensions, and a new framework was developed. This research used the ‘mixed-method-simple’ methodological approach, which combines qualitative and quantitative data. Questionnaires, structured in-depth interviews, observation, and document analysis were used. This study employed a survey as its research strategy and used a cross-sectional approach.

4.2 Data Presentations

This section presents the results of the collected data through questionnaires, interviews, observations, and document analysis.

The types of manufacturing industries involved (appendix 2) in this study were textile, clothing and footwear, building and construction material, mechanical, engineering, industrial polymers, industrial glass, and industrial ceramics, energy, mineral, chemical, soap, and detergent, automotive and spare parts, papermaking industry, pharmaceutical, and food and beverage. Appendix 2 shows the company type, size, and location.

4.3 Descriptive Analysis

Descriptive statistics such as percentages, means, frequencies, standard deviations and other relevant measures were used to understand and investigate sustainable supply chain practices in the Ethiopian manufacturing industry (RO1). These statistics provide a systematic description of the observed data before undertaking further inferential analysis. Interpretation of the findings, their implication, and comparison with the existing literature are addressed separately in the discussion chapter, chapter 5. The data was collected through a questionnaire (See Appendix 1) and this section presents the descriptive results.

4.3.1 Environmental Policy and Management System

As part of the environmental policy and system, manufacturers were asked whether they have company-level environmental policies. Figure 6 presents manufacturers' response concerning the company-level environmental policy manual. According to results from 86 manufacturers, 77% already have a company-level environmental policy/manual in place.

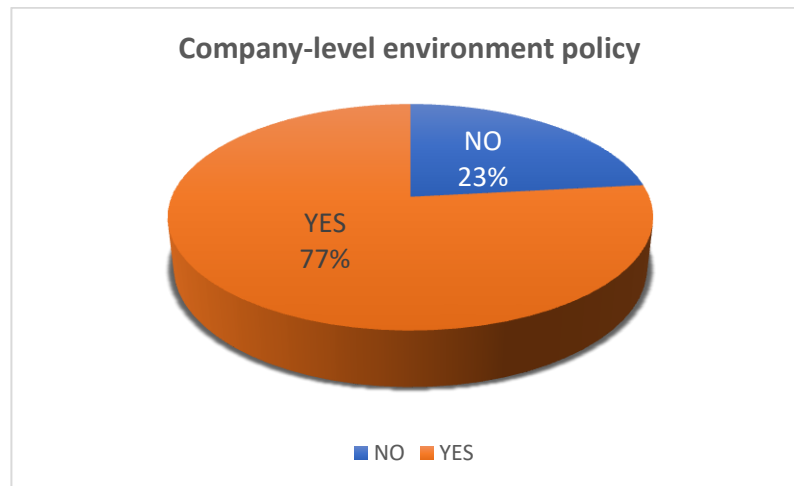


Figure 6 Company-level environmental policy

Manufacturers were also questioned on who the responsible body for the environmental issues would be; accordingly, Figure 7 shows the results for it.

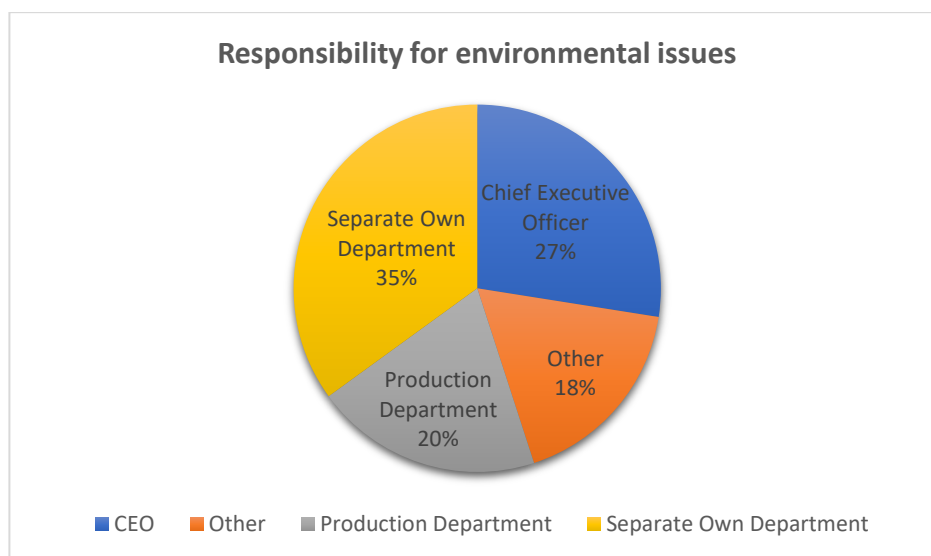


Figure 7 Responsible Body for Environmental Issues

Manufacturers were also asked how frequently they monitor and evaluate their company's environmental performance. Figure 8 presents the manufactures' response regarding the periodic monitoring and evaluation of environmental performance.

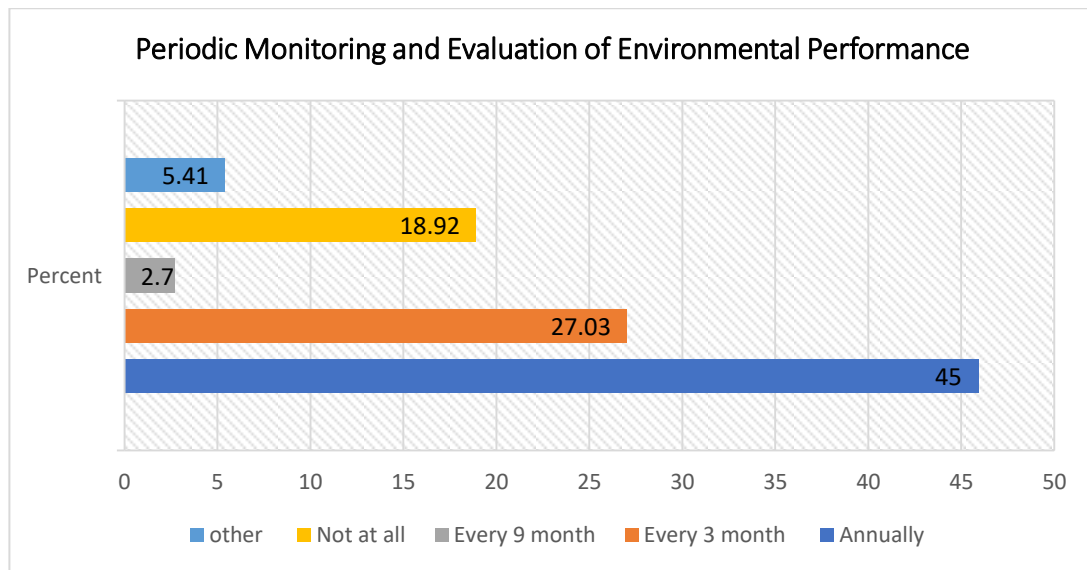


Figure 8 Periodic monitoring and evaluation of environmental performance

Moreover, manufacturers were asked how frequently they assess environmental risks in their sustainable supply chains. Therefore Figure 9 illustrates the responses of manufacturers' regarding the frequency of assessing risks associated with the environment.

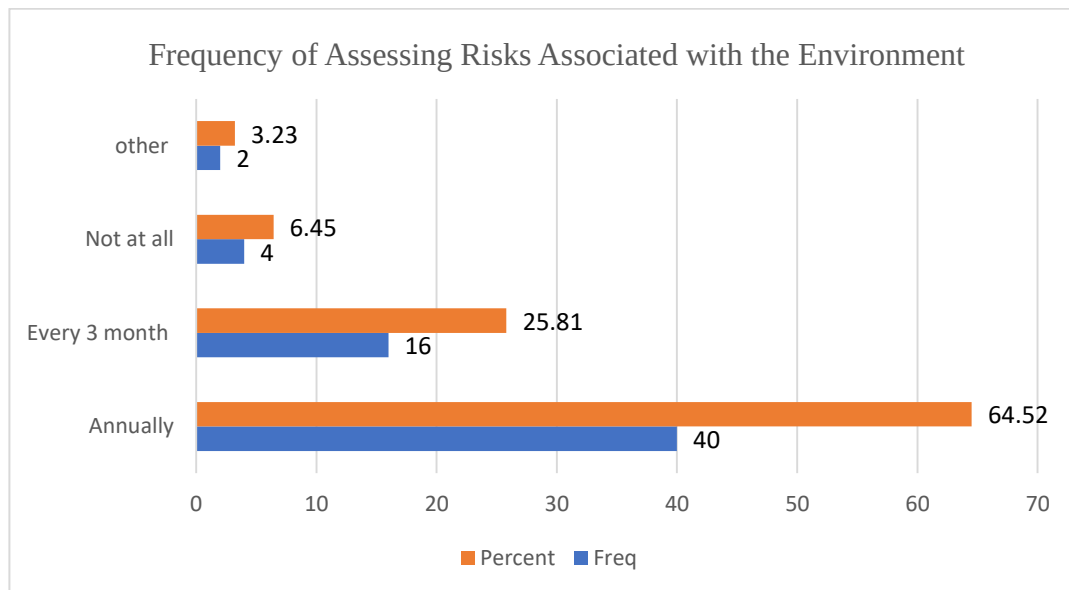


Figure 9 Frequency of Assessing Risks Associated with the Environment

The manufacturers were asked whether their company has set clear objectives and targets to increase energy efficiency. Figure 10 shows the response concerning setting objective and target to increase energy efficiency.

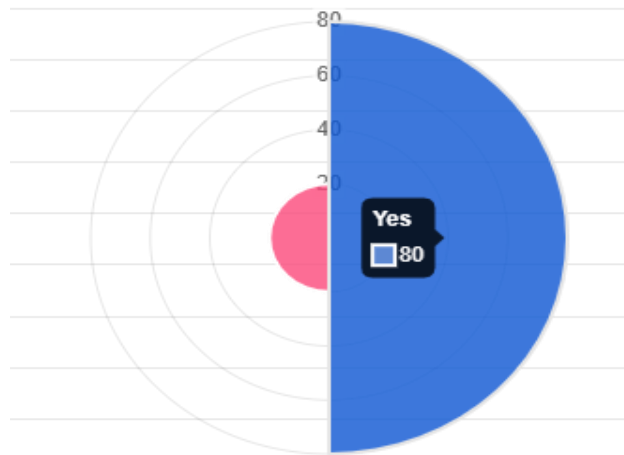


Figure 10 Objective and target to increase energy efficiency

Figure 11 shows manufacturers' practices regarding reporting GHG emissions to the Carbon Disclosure Project (CDP) or the public. As a result, more than 64% of the manufacturers reported not having a practice of reporting their GHG inventory to the CDP or the public.

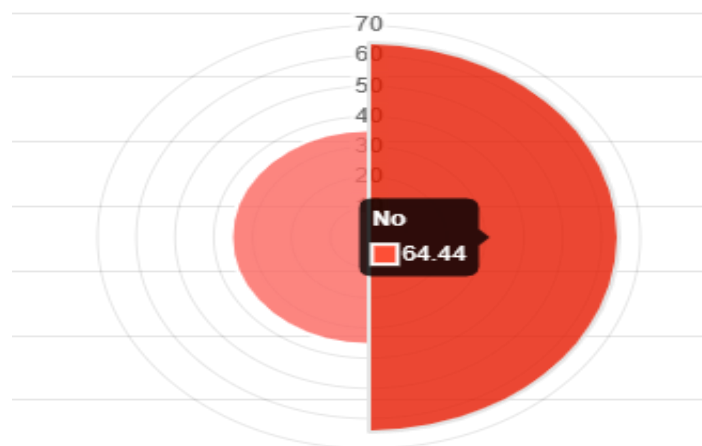


Figure 11 Report GHG emissions to the Carbon Disclosure Project (CDP) or the public

Figure 12, depicts the results regarding manufacturing firms' practices in setting energy-use reduction targets.

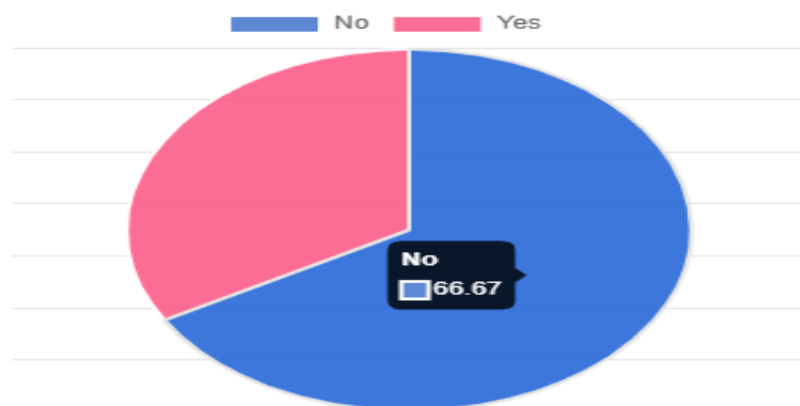


Figure 12 publicly setting energy use reduction targets

4.3.2 Sustainability Supply Chain Management Process and the Environment

Table 8 presents the results of manufacturers' responses towards the level of environmental consideration they incorporate into their supply chain operations in collaboration with their suppliers and major customers.

Table 8 Sustainability Supply Chain Management Process and the Environment

Variable	Obs	Mean	Std. Dev.
Level of consideration for products that can be reused, recycled, and recovered of their components	86	2.233	.645
Level of consideration for products to reduce the use of harmful/toxic materials	86	2.628	.575
Level of consideration for optimisation of design processes to reduce air emissions and noise	86	2.465	.627
Level of consideration for optimisation of design processes to reduce solid and liquid waste	86	2.488	.628
Work in collaboration with customers on green and cleaner production processes	86	2.256	.723
Work in collaboration with customers for green packaging	86	2.256	.814
Work in collaboration with customers to use less energy while transporting a product	86	2.256	.723
Mechanism to enable sustainability information sharing with customers	86	2.14	.738
Work in collaboration with suppliers to minimise the energy in transporting a product	86	2.023	.703
Work in collaboration with suppliers to achieve environmental objectives	86	2.093	.777
Level of consideration to purchase eco-friendly materials	86	2.326	.562

4.3.3 Social Dimensions Practices

The social sustainability dimension of this study includes Occupational Health and Safety Standard Certification, community engagement, human resource practices, the existence of trade unions, and corporate social responsibility.

4.3.3.1 Corporate Social Responsibility (CSR)

According to results from Ethiopian manufacturing firms, Figure 13 reports whether the manufacturers possess a formal corporate social responsibility policy in place.

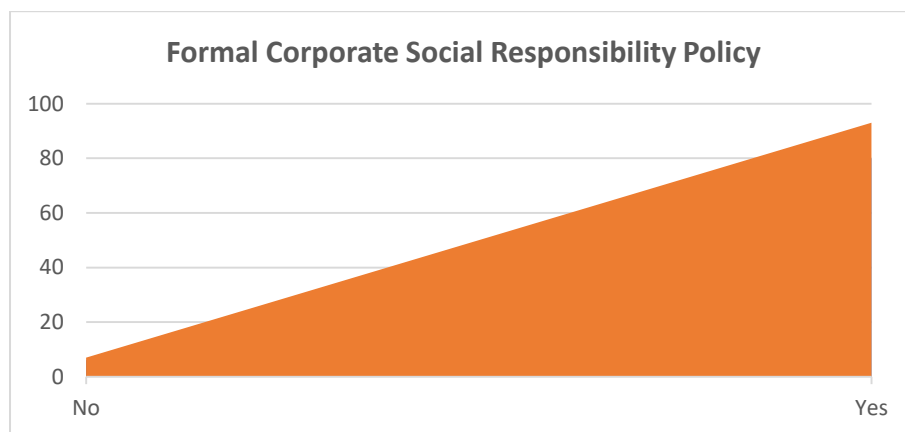


Figure 13 Formal Corporate Social Responsibility (CSR) Policy

4.3.3.2 Community Engagement Practices

Four items were used to assess the community engagement of the manufacturing firms of this study; as a result Figure 14 summarises manufacturers' response regarding community engagement practices.

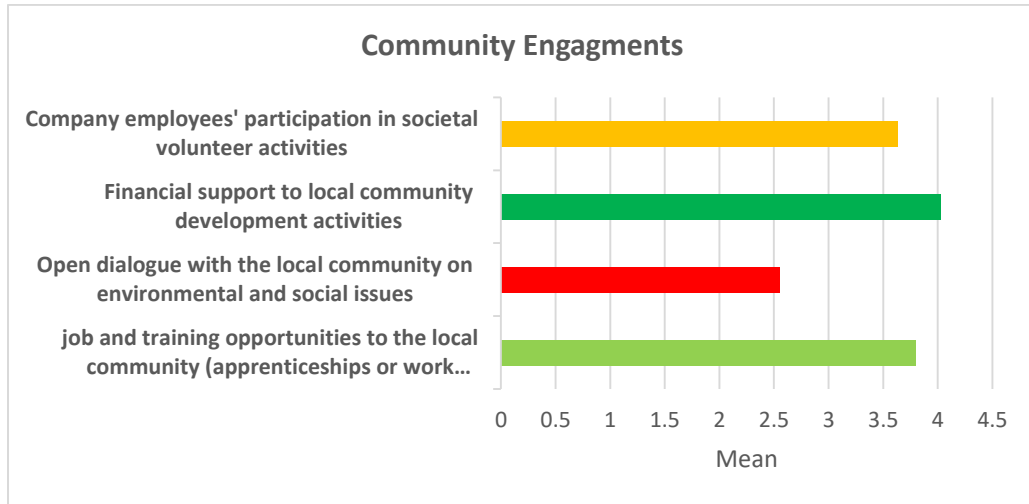


Figure 14 Community engagement of the manufacturing firms

4.3.3.3 Occupational Health and Safety Standard Certification

Figure 15 demonstrates the manufacturers' response in relation to OH&S certification.

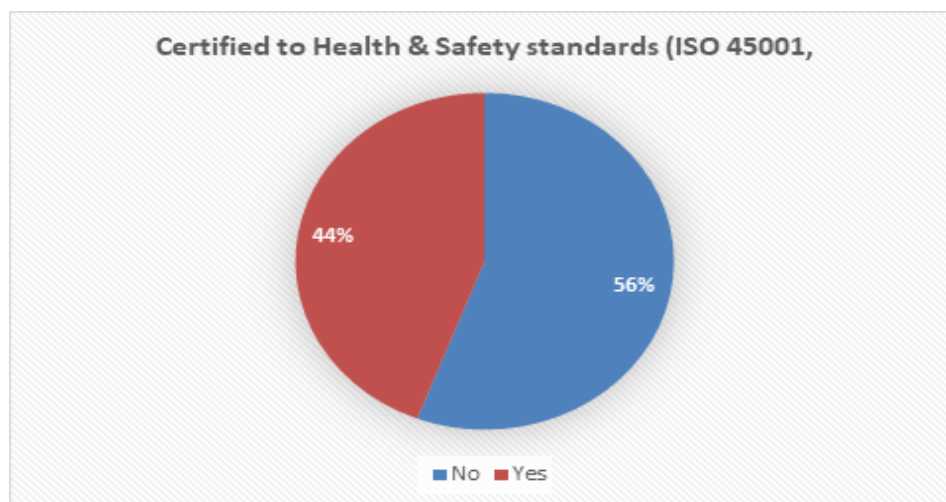


Figure 15 Certified to Health & Safety Standards (ISO 45001)

4.3.3.4 Human Resource Practice

The results in Table 9 show that manufacturing firms' response to human resource policies and practices they adopt.

Table 9 Human Resource Practice

	Observation	Yes		No	
		Frequency	%	Frequency	%
The company has an official personnel policy in place that covers discipline and termination	86	80	93.02	6	6.98
The company has an official personnel policy in place that covers grievance procedures	86	78	90.70	8	9.30
The company has an official personnel policy that addresses harassment and abuse.	86	74	86.05	12	13.95
The company has an official personnel policy in place that covers overtime wage rates	86	76	88.37	10	11.63
The company has an official personnel policy in place that covers vacation and leave	86	76	88.37	10	11.63

4.3.3.5 Trade Union

Figure 16 displays the responses reaped from manufacturers' regarding the existence of trade unions in their companies.

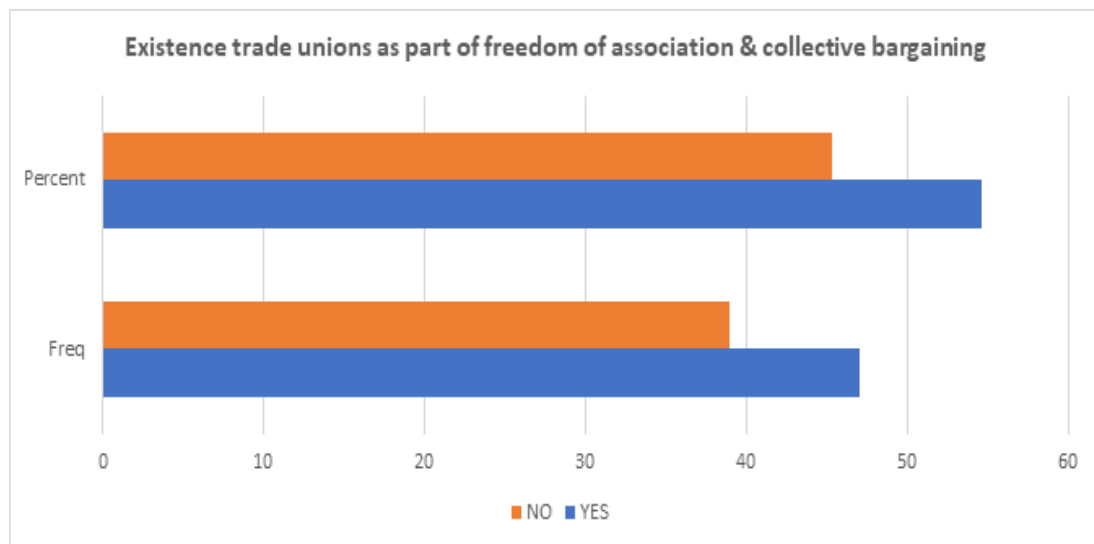


Figure 16 The existence of a trade union

4.3.4 Supplier Integration

In this study, manufacturers were assessed on the level of integration they have with their suppliers. Table 10 presents the manufacturers' responses regarding their relationship with their suppliers, which is the buyer-supplier relationship.

Table 10 Mean Result of the Supplier Integration

Variable	Obs	Mean	Std. Dev.
The company awards its suppliers for quality	86	3.686	1.239
The company demands that suppliers sign the code of conduct as a prerequisite to working together	86	3.698	1.256
The company requests that the supplier perform a self-assessment annually/semi annually	86	3.477	1.185
The company only works with certified suppliers	86	3.849	1.163
The company shares data and information on environmental goals with suppliers.	86	3.395	1.171
The company shares data and information on environmental practices with suppliers.	86	3.337	1.144

The company shares product environmental requirements with suppliers.	86	3.5	1.071
The company shares data and information on green production with suppliers.	86	3.349	1.015
The company supports suppliers in improving their environmental awareness.	86	3.419	1
The company supports suppliers in designing their own environmental programs.	86	3.349	1.015
The company provides financial support to suppliers to purchase equipment for pollution prevention	86	3.093	.835
The company supports suppliers to improve their operational processes and green performance	86	3.279	.929
The company provides learning and experience-sharing on environmental management among suppliers.	86	3.326	.939
The company works with suppliers to accomplish the closed-loop return process.	86	3.279	.903
The company works with suppliers to achieve planning, distribution and outbound logistics planning	86	3.64	1.116
The company jointly decides on environmental impact reduction means with suppliers	86	3.279	1.144
The company is keen to establish a long-term relationship with its suppliers	86	3.209	.869
The company consults crucial suppliers in new product development processes	86	3.698	.983

4.4 Drivers and Barriers of Sustainable Supply Chain Practice

4.4.1 Analysis of Drivers and Barriers of Sustainable Supply Chain Practice

Factor analysis has been employed to investigate the driving factors and barriers affecting sustainable supply chain practices. The goal of factor analysis is to explain the covariances or correlations among variables. It will help reduce the data into fewer components and identify the main drivers and barriers. Factor analysis is a method for investigating whether several variables of interest are linearly related to a smaller number of unobservable factors. Factor analysis is a collection of methods used to examine how underlying constructs influence responses to multiple measured variables. According to factor analysis, both underlying common factors and unique variables affect each observable response. By examining the pattern of correlations (or covariances) among the observed measurements, factor analyses are performed. Relatively uncorrelated measurements are likely influenced by different factors, whereas highly correlated measures (either positive or negative) are likely influenced by the same factors. The tables 11 and 12 present descriptive statistics on the drivers and barriers of sustainable supply chain management, respectively.

Table 11 presents descriptive statistics of the variables used in the study. “Obs” indicates the number of observations (N = 86). The “Mean” represents the average response of participants based on a Likert scale, reflecting the overall importance or agreement level for each factor. The “Std. Dev.” (standard deviation) shows the variability or dispersion of responses around the mean. “Skew.” (skewness) measures the symmetry of the distribution, where negative values indicate a concentration of responses toward higher ratings and positive values indicate concentration toward lower ratings. “Kurt.” (kurtosis) reflects the peakedness of the distribution, with higher values indicating more concentrated responses around the mean.

Table 11 Driving factors- Descriptive statistics

Variables	Obs	Mean	Std. Dev.	Skew.	Kurt.
Government regulatory factors	86	4.116	1.034	-1.262	4.455
Company Geographical location	86	3.616	1.209	-.595	2.451
International regulatory factors	86	3.535	1.175	-.434	2.476
Professional associations	86	3.186	1.183	.064	1.86
Certification as a regulatory factor	86	3.663	1.144	-.547	2.494
Financial incentives from the government	86	3.291	1.282	-.387	2.007
Competitive advantage	86	3.674	.887	-.537	3.522
Expectations from shareholders	86	3.605	1.23	-.587	2.339
Competitors' sustainability practices	86	3.57	1.091	-.508	2.643
Customer	86	3.884	1.067	-.818	2.889
Company image and reputation	86	3.814	1.133	-.999	3.459
Globalisation	86	2.977	1.158	-.686	1.969
Local inhabitants (public)	86	3.384	.996	-.538	2.825
Media	86	3.058	1.022	-.116	2.553
NGO working in sustainability	86	2.442	.889	.328	3.266
Consumer associations	86	3.174	.996	-.211	2.461
Top management commitment	86	4.151	.805	-1.369	6.526
Operational performance	86	4.186	.847	-1.529	6.414
Reduce the environmental impact	86	3.523	.904	-.646	3.154
Profitability and productivity	86	3.953	.906	-1.149	4.581
Sociocultural responsibility	86	3.337	1.001	-.43	2.712
Business ethics	86	3.407	.845	.059	3.526
Health issues	86	3.488	1.135	-.263	2.294
Resource depletion	86	3.651	1.038	-.662	3.147
Employees	86	3.86	.984	-.761	3.25
Better workplace environment	86	3.953	.919	-.822	3.819
Company Size	86	3.674	1.1	-.609	2.765

Table 12 Barrier Factors - Descriptive Statistics

Variables	Obs	Mean	Std. Dev.	Skew.	Kurt.
Absence of government policies and incentives	86	4	.958	-.323	1.781
Cost of sustainable supply chain implementation	86	4.058	.772	-.407	2.597
Cost of environmentally friendly raw materials	86	3.895	.946	-.629	3.288
Absence of organisational strategy for sustainability	86	3.779	.887	-.574	3.649
Absence of the ability to engage in sustainable practice	86	3.733	.951	-.602	3.187
Inadequate commitment by top management	86	3.919	1.098	-.805	2.735
Absence of employee motivation in adopting SSCM	86	3.942	.974	-.805	3.389
Unnecessary Organisational Bureaucracy	86	3.721	.978	-.785	3.802
Absence of knowledge and training	86	3.953	1.016	-.854	3.22
Absence of customer serious demand for sustainable products/solutions	86	3.663	1.058	-.732	3.073
Reluctance of customers to share costs	86	2.488	1.155	.074	2.215
Absence of customer awareness about sustainability	86	2.419	1.232	.075	1.666
Absence of societal awareness about sustainability	86	2.581	1.122	-.18	2.039
Unwillingness from suppliers to collaborate and/or share information	86	2.512	1.196	-.069	1.77
Insufficient regulatory requirements	86	2.302	1.32	.295	1.524

When the data are suitable, a correlation matrix is produced by computing the correlation between every pair of variables. A correlation matrix (see Tables 13 and 14) shows how different variables relate to one another.

Table 13 Driver Factors Matrix of Correlations

	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1	Government regulatory factors	1.000																										
2	Company Geographical location	0.365	1.000																									
3	International regulatory factors	0.452	0.485	1.000																								
4	Professional associations	0.328	0.519	0.520	1.000																							
5	Certification as a regulatory factor	0.402	0.220	0.740	0.403	1.000																						
6	Financial incentives from the government	0.409	0.118	0.153	0.080	0.164	1.000																					
7	Competitive advantage	0.196	0.387	0.304	0.141	0.262	-0.143	1.000																				
8	Expectation from shareholders	0.370	0.276	0.246	0.391	0.222	0.148	0.334	1.000																			
9	Competitors sustainability practices	0.368	0.489	0.540	0.437	0.382	-0.010	0.608	0.468	1.000																		
10	Customer	0.311	0.402	0.482	0.260	0.449	0.214	0.407	0.484	0.664	1.000																	
11	Company image and reputation	0.220	0.514	0.429	0.483	0.369	0.005	0.548	0.555	0.563	0.624	1.000																
12	Globalisation	0.238	0.069	0.217	0.055	0.163	0.139	-0.007	0.374	-0.017	0.226	0.068	1.000															
13	Local inhabitants (public)	0.059	0.338	0.355	0.488	0.177	-0.061	0.276	0.164	0.544	0.264	0.460	-0.125	1.000														
14	Media	0.205	0.399	0.474	0.507	0.238	-0.058	0.489	0.505	0.720	0.481	0.640	0.051	0.637	1.000													
15	NGO working in sustainability	-0.005	0.291	0.334	0.368	0.148	-0.176	0.304	0.054	0.465	0.104	0.410	0.033	0.524	0.645	1.000												
16	Consumer associations	0.151	0.310	0.572	0.581	0.465	-0.013	0.145	0.076	0.438	0.418	0.425	-0.190	0.489	0.487	0.443	1.000											
17	Top management commitment	0.474	0.375	0.473	0.427	0.516	0.174	0.136	0.251	0.397	0.559	0.367	0.244	0.323	0.290	0.202	0.451	1.000										
18	Operational performance	0.459	0.553	0.419	0.294	0.357	0.275	0.520	0.342	0.546	0.545	0.527	0.076	0.333	0.259	-0.017	0.240	0.579	1.000									
19	Reduce the environmental impact	0.249	0.304	0.520	0.404	0.404	-0.004	0.404	0.101	0.505	0.303	0.505	0.004	0.404	0.404	0.403	0.302	0.303	0.303	1.000								

Table 14 Barrier Factors Matrix of Correlations

	Factors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Absence of government policies and incentives	1.000														
2	Cost of sustainable supply chain implementation	0.620	1.000													
3	Cost of environmentally friendly raw materials	0.558	0.733	1.000												
4	Absence of an organisational strategy for sustainability	0.263	0.277	0.183	1.000											
5	Absence of the ability to engage in sustainable practice	0.116	0.294	0.139	0.780	1.000										
6	Inadequate commitment by top management	0.280	0.186	0.003	0.695	0.621	1.000									
7	Absence of employee motivation in adopting SSCM	0.214	0.130	0.095	0.720	0.643	0.699	1.000								
8	Unnecessary Organisational Bureaucracy	-0.050	-0.009	-0.007	0.525	0.602	0.505	0.551	1.000							
9	Absence of knowledge and training	0.314	0.273	0.240	0.667	0.498	0.608	0.734	0.413	1.000						
10	Absence of customer serious demand for sustainable products/solutions	0.244	0.283	0.411	0.396	0.330	0.523	0.563	0.363	0.707	1.000					
11	Reluctance of customers to share costs	0.000	-0.124	0.015	-0.066	0.024	-0.163	-0.069	0.018	-0.201	-0.258	1.000				
12	Absence of customer awareness about sustainability	0.160	-0.038	0.149	-0.097	-0.195	-0.018	0.011	0.020	-0.003	-0.044	0.417	1.000			
13	Absence of societal awareness about sustainability	0.066	0.001	0.202	-0.023	-0.150	-0.181	-0.087	-0.215	-0.100	0.018	0.377	0.520	1.000		
14	Unwillingness from suppliers to collaborate and/or share information	0.226	0.108	0.246	-0.059	-0.013	-0.102	0.056	0.124	0.000	-0.039	0.294	0.124	0.039	1.000	
15	Insufficient regulatory requirements	0.260	0.225	0.205	0.188	0.206	0.171	0.114	-0.007	0.028	-0.086	0.334	0.225	0.166	0.423	1.000

In factor analysis aimed at identifying the drivers and barriers of sustainable supply chain management (SSCM), eigenvalues indicate the extent to which each factor accounts for the overall variance in the data. Eigenvalues show how much of the total variance in the data each factor explains. A higher eigenvalue means that the factor captures more information about the relationships among variables. Generally, factors with eigenvalues exceeding 1 are retained for analysis since they indicate significant groupings of associated variables (see Table 15 and Table 16). In this context, eigenvalues help identify the most significant underlying factors that drive or hinder sustainability performance in the supply chain. The unique collection of scalar values, the eigenvalues, is associated with the set of linear equations, most likely in matrix form. The eigenvector is transformed using the eigenvalue, which is a scalar. An eigenvector is a real, non-zero eigenvalue, whereas an eigenvalue is a factor that causes it to be stretched.

Assumption

Eigenvalue is extracted from the correlation matrix and all the variables are perfectly independent of each other

Table 15 Drivers Eigenvalue

(obs=86)				
Factor analysis/correlation		Number of obs	=	86
Method: principal-component factors. Retained factors		=	6	
Rotation: (unrotated)		Number of params	=	147
Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	10.629	7.724	0.394	0.394
Factor2	2.905	1.015	0.108	0.501
Factor3	1.890	0.207	0.070	0.571
Factor4	1.683	0.337	0.062	0.634
Factor5	1.346	0.221	0.050	0.683
Factor6	1.125	0.140	0.042	0.725
Factor7	0.985	0.179	0.036	0.762
Factor8	0.806	0.049	0.030	0.791
Factor9	0.757	0.014	0.028	0.820
Factor10	0.743	0.110	0.028	0.847
Factor11	0.633	0.113	0.023	0.870
Factor12	0.520	0.027	0.019	0.890
Factor13	0.493	0.049	0.018	0.908
Factor14	0.444	0.078	0.016	0.924
Factor15	0.366	0.059	0.014	0.938
Factor16	0.307	0.028	0.011	0.949
Factor17	0.279	0.050	0.010	0.960
Factor18	0.229	0.033	0.009	0.968
Factor19	0.197	0.028	0.007	0.975
Factor20	0.169	0.030	0.006	0.982
Factor21	0.139	0.043	0.005	0.987
Factor22	0.096	0.004	0.004	0.990
Factor23	0.093	0.013	0.003	0.994
Factor24	0.079	0.035	0.003	0.997
Factor25	0.044	0.019	0.002	0.998
Factor26	0.025	0.007	0.001	0.999
Factor27	0.018	.	0.001	1.000

Table 16 Barriers Eigenvalue

(obs=86)				
Factor analysis/correlation		Number of obs	=	86
Method: principal-component factors		Retained factors	=	4
Rotation: (unrotated)		Number of params	=	54
Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	4.868	2.264	0.325	0.325
Factor2	2.604	0.749	0.174	0.498
Factor3	1.855	0.546	0.124	0.622
Factor4	1.308	0.398	0.087	0.709
Factor5	0.910	0.156	0.061	0.770
Factor6	0.754	0.145	0.050	0.820
Factor7	0.609	0.122	0.041	0.861
Factor8	0.487	0.074	0.033	0.893
Factor9	0.413	0.074	0.028	0.921
Factor10	0.339	0.106	0.023	0.943
Factor11	0.233	0.021	0.015	0.959
Factor12	0.213	0.031	0.014	0.973
Factor13	0.181	0.033	0.012	0.985
Factor14	0.149	0.073	0.010	0.995
Factor15	0.076	.	0.005	1.000

To arrive to the final factors as drivers and barriers, factors need to be rotated. There are essentially an infinite number of ways to define your factors and yet account for the same amount of covariance in your measures for any given set of correlations and number of factors. The goal of rotating your factors is to find a factor solution with the simplest interpretation that is equivalent to the one obtained in the initial extraction.

The tables below (see Tables 17 and 18) present the rotated factor loadings and unique variances for drivers and barriers of sustainable supply chain management, respectively.

Table 17 Rotated factor loadings (pattern matrix) and unique variances for drivers

Variable	Factor1	Factor2	Factor3	Factor4	Uniqueness
Government regulatory factors	0.665	-0.117	-0.044	0.022	0.636
Company Geographical location	0.461	0.201	0.048	0.134	0.562
International regulatory factors	0.452	0.402	-0.056	0.001	0.504
Professional associations	0.246	0.649	0.072	-0.354	0.384
Certification as regulatory factors	0.427	0.136	0.081	0.037	0.681
Financial incentives from the government	0.550	-0.332	0.086	-0.229	0.689
Competitive advantage	0.154	0.030	-0.055	0.959	0.000
Expectations from shareholders	0.437	0.160	-0.165	0.163	0.723
Competitors' sustainability practices	0.315	0.501	0.010	0.299	0.264
Customer	0.616	0.108	0.058	0.135	0.435
Company image and reputation	0.235	0.384	0.224	0.256	0.353
Globalisation	0.299	-0.060	-0.140	-0.052	0.938
Local inhabitants (public)	0.049	0.713	-0.040	-0.014	0.487
Media	0.044	0.777	-0.071	0.184	0.280
NGO working in sustainability	-0.354	0.882	0.005	0.076	0.349

Consumer associations	0.191	0.635	-0.063	-0.160	0.539
Top management commitment	0.670	0.156	-0.084	-0.140	0.519
Operational performance	0.851	-0.204	0.026	0.300	0.214
Reduce the environmental impact	0.061	0.463	0.149	0.207	0.540
Profitability and productivity	0.727	0.036	0.001	0.212	0.328
Sociocultural responsibility	-0.096	0.736	0.192	-0.053	0.405
Business ethics	0.004	0.127	0.596	0.127	0.499
Health issues	-0.033	0.137	0.978	-0.120	0.000
Resource depletion	0.229	-0.195	0.743	0.215	0.234
Employees	0.615	0.035	0.198	0.043	0.414
Better workplace environment	0.507	-0.014	0.519	-0.244	0.275
Company Size	0.700	0.012	0.089	-0.070	0.451

Table 18 Rotated factor loadings (pattern matrix) and unique variances for Barriers

Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8	Factor9	Factor10	Uniqueness
Absence of government policies and incentives	0.023	-0.019	0.198	0.582	-0.108	-0.145	0.132	-0.195	0.139	0.072	0.371
Cost of sustainable supply chain implementation	0.052	0.072	0.021	0.959	-0.042	0.039	-0.074	0.102	-0.117	-0.060	0.144
Cost of environmentally friendly raw materials	0.038	-0.082	-0.219	0.812	0.224	0.045	0.080	-0.047	0.086	0.031	0.174
Absence of organisational strategy for sustainability	0.819	0.085	0.053	0.027	-0.141	0.111	-0.107	-0.012	-0.060	0.479	0.000
Absence of ability to engage in sustainable practice	0.965	-0.017	0.012	0.125	-0.008	0.020	-0.092	-0.026	-0.092	-0.221	0.000
Inadequate commitment by top management	0.227	-0.070	0.911	-0.077	0.187	0.059	0.022	0.070	-0.093	0.015	0.000
Absence of employee motivation in adopting SSCM	0.575	0.122	0.120	-0.160	0.148	-0.055	0.094	-0.325	0.127	0.019	0.244
Unnecessary Organisational bureaucracy	0.191	-0.020	0.056	0.019	0.037	0.899	0.081	-0.003	0.074	0.056	0.000
Absence of knowledge and training	0.131	0.896	-0.096	0.012	0.211	-0.016	0.044	0.019	-0.008	0.036	0.000
Absence of customer serious demand for sustainable products/solutions	-0.067	0.092	0.188	0.078	0.911	0.032	-0.055	-0.027	0.021	-0.070	0.000
Reluctance of customers to share costs	0.148	-0.030	-0.115	-0.113	-0.107	0.022	0.427	0.180	0.208	-0.091	0.519
Absence of customer awareness about sustainability	-0.187	0.072	0.085	0.058	-0.097	0.111	1.006	-0.074	-0.108	-0.067	0.174
Absence of societal awareness about sustainability	0.071	-0.079	-0.117	-0.021	0.184	-0.137	0.537	0.167	-0.093	0.162	0.402
Unwillingness from suppliers to collaborate and/or share information	-0.129	-0.006	-0.124	-0.007	0.039	0.077	-0.135	0.046	0.951	-0.015	0.205
Insufficient regulatory requirements	0.077	0.054	0.278	0.080	-0.056	-0.078	0.044	0.439	0.381	0.025	0.486

4.5 Quantitative Environmental Sustainability Indicators

The primary quantitative metrics employed by manufacturers include carbon footprint, energy consumption, water consumption, and waste management and recycling.

4.5.1 Energy Consumption Management

Table 19 and Figures 17 and 18 illustrates the greenhouse gas (GHG) emissions, energy use, water consumption, and waste and recycling practices of manufacturers, categorised by type, across their supply chains.

Table 19 Energy Consumption Management Quantitative Indicators

	Indicators	Measure	Type of Manufacturing			
			Textile, Clothing, and Footwear	Paper Industry	Building and Construction	Food and Beverage
1.	<i>Annual Energy consumption</i>	MWh	51833	60	269	52
2.	<i>Annual Steam consumption</i>	MWh	2726	40	488	1
3.	<i>Amount of generated carbon monoxide</i>	Metric tons	235295.5		504000	780
4.	<i>Share of energy-efficient devices</i>	%	65	60	72.5	60

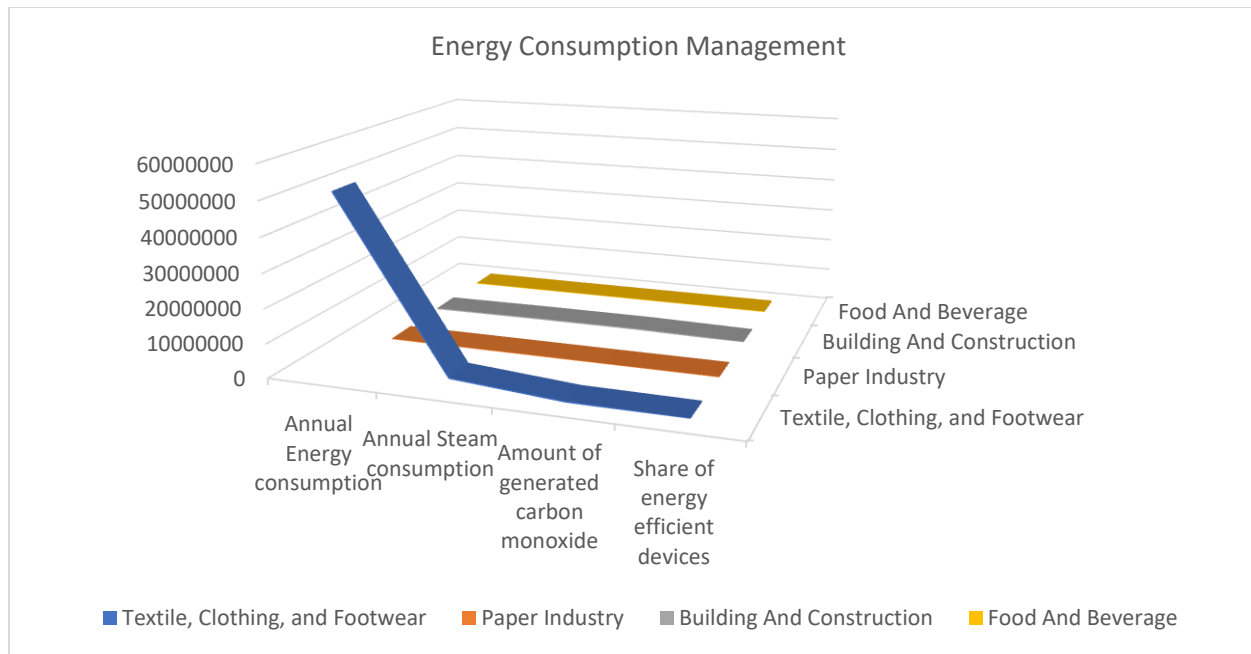


Figure 17 Energy Consumption Quantitative Indicators

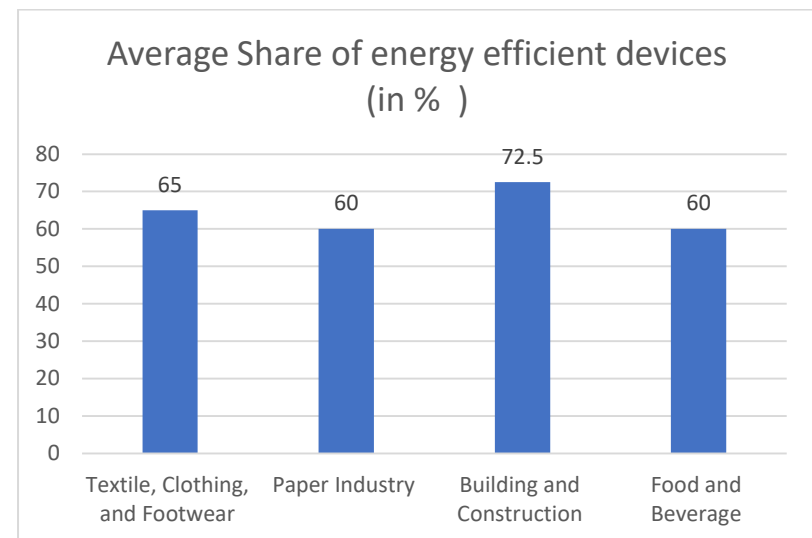
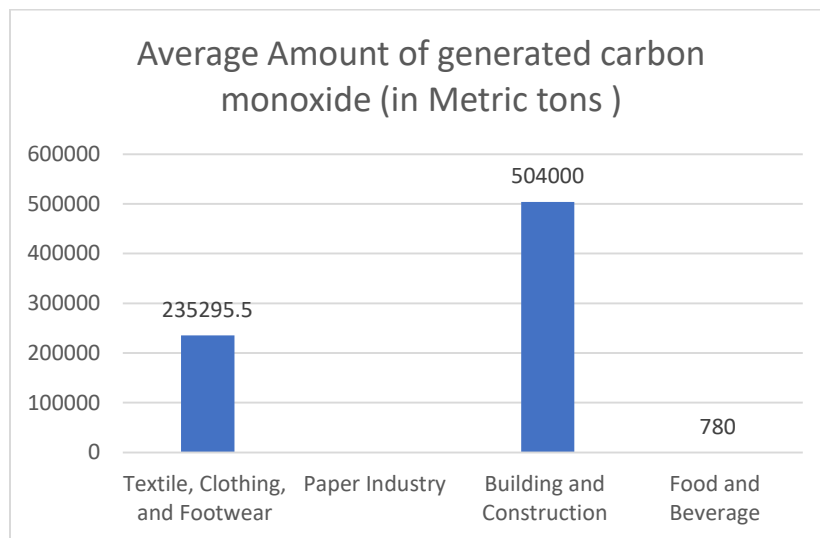
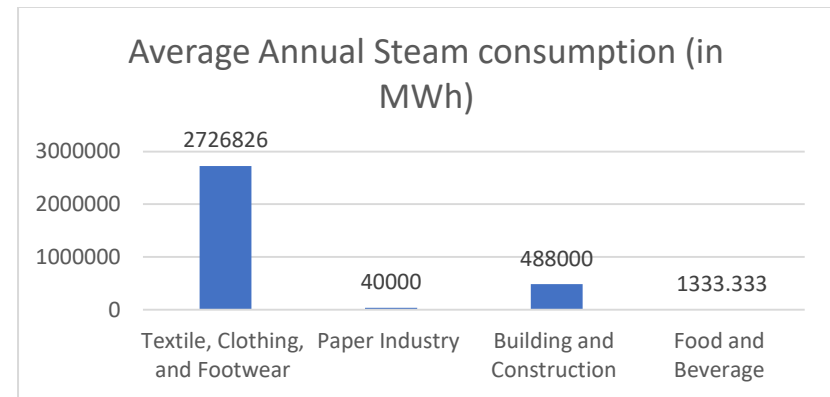
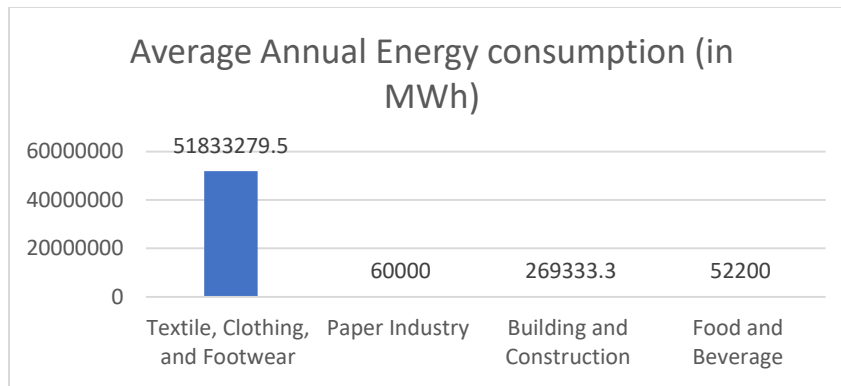


Figure 18 Energy consumptions

As depicted in Table 19 and Figures 17 and 18, the average annual energy consumption (in MWh) is 51833, 60, 269, and 52 for textile, clothing and footwear, paper industry, building and construction, and food and beverage manufacturing, respectively. Moreover, the average annual steam consumption (in MWh) is 2726.8, 40.0, 488.0, and 1.3 for textile, clothing and footwear, paper, building and construction, and food and beverage manufacturing, respectively.

4.5.2 Water Management

As shown in Table 20, the average annual water consumption (in Litres) is 61625000, 150000, 2633416667, 24823000, and 250000 for Textile, Clothing and Footwear, Paper Industry, Building and Construction, Food and Beverage, and Automotive, respectively. Furthermore, the annual generated wastewater (in litres) is 1838500, 75000, 552000, 30027200, and 3000000 for Textile, Clothing and Footwear, Paper Industry, Building and Construction, Food and Beverage, and Automotive, respectively.

Table 20 Water Management Quantitative Indicators

No		Measure	Type of Manufacturing				
			Textile, Clothing and Footwear	Paper Industry	Building and Construction	Food and Beverage	Automotive
1	Annual Water Consumption	Litre	61625000	150000	2633416667	24823000	250000
2	Annual Generated wastewater	Litre	1838500	75000	552000	30027200	3000000
3	Water recycled internally	Litre	80000		80000	251400	20000
4	Annual Share of industrial water in total consumption	%	17	95	92.5	60.5	
5	Share of devices with efficient utilisation of used water	%	36	80	65	25	

4.5.3 Waste Management

Table 21 and Figure 20 show the manufacturers' total annual average waste generated and the percentage of waste recycled.

Table 21 Waste Management Quantitative Indicator

	Indicators	Measure	Type of Manufacturing			
			Textile, Clothing, and Footwear	Paper Industry	Building and Construction	Food and Beverage
1.	Landfill waste in Tons	Tons	21		20000	628
2.	Water Waste in Tons	Tons	4		158000	526.5
3.	Paper consumption Cut	%	42			28.75
4.	Share of recycled toxic waste	%	13			18.25

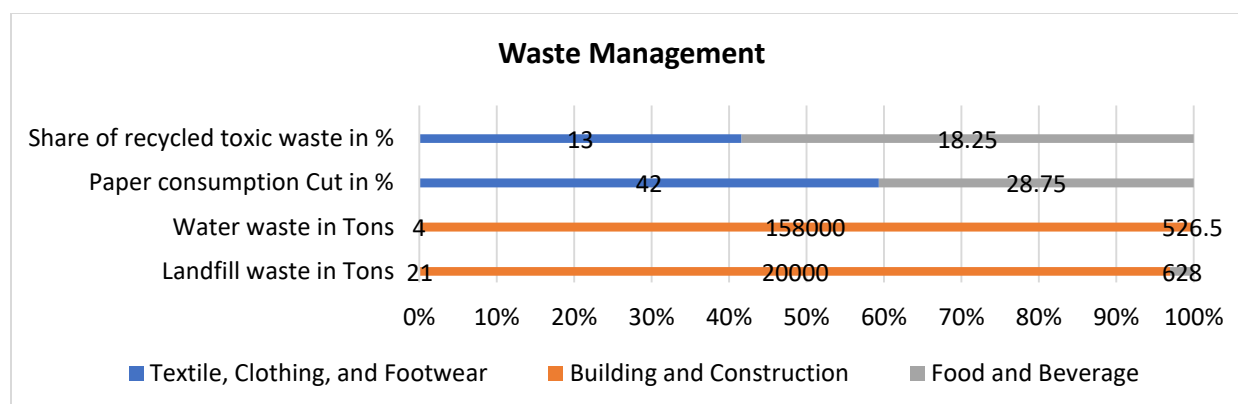


Figure 19 Waste Management among sectors

By using these quantitative environmental sustainability metrics and approaches, manufacturers in Ethiopia can monitor and improve their environmental sustainability performance, meet international standards, and support the nation's broader environmental goals. According to its revised NDC (Nationally Determined Contributions) national climate action plans, Ethiopia plans to reduce its GHG emissions by 68.8% (-278 MtCO₂eq) in 2030 compared to a BaU (Business as Usual) scenario, and by 8.8% (-278 MtCO₂eq) with international support (energy, 2025).

4.6 Determinants of Sustainable Supply Chain Performance

This section presents the determinants of SSC practice. Ordinary least square was employed as an estimator for the linear regression model to analyse the obtained data. Ordinary Least Squares (OLS) is a widely used econometric method for estimating the relationship between a dependent variable and several independent variables. Within the framework of Sustainable Supply Chain Performance, OLS is efficiently utilised to quantify and assess the determinants that significantly impact sustainability results in the manufacturing sector.

4.6.1 Ordinary Least Squares as an estimator for the linear regression model

A linear regression model is a powerful tool for investigating the relationships between multiple variables by relating one continuous outcome variable to a set of independent variables (Verbeek, 2017). It is relatively easy and convenient to establish empirical relationships between a single dependent/outcome variable and a set of independent/factor variables. With certain strong, basic assumptions fulfilled, it yields plausible results. The estimation technique (OLS)

minimises the residual sum of squares when estimating the parameters. The general model looks like:

$$Y = X\beta \quad (3)$$

Where:

Y is the outcome/dependent variable;

X-the vector of independent variables; and

β -is the vector of the parameters, including the constant term.

Linear regression: Gross Profit

Table 22 Linear regression: Gross Profit

Gross Profit	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Environmental Policy	3.636e+09	1.654e+09	2.20	.038	2.152e+08	7.057e+09	**
Environmental management system certification	1.772e+09	9.022e+08	1.96	.062	-94705069	3.638e+09	*
Energy audit	1.428e+09	1.039e+09	1.37	.182	-7.127e+08	3.569e+09	
Waste disposal audit	7.380e+08	1.273e+09	0.58	.567	-1.884e+09	3.360e+09	
Design for the Environment (DfE)	10764204	1.643e+09	0.01	.995	-3.374e+09	3.395e+09	
Chemical substance inventory	7.081e+08	1.547e+09	0.46	.651	-2.477e+09	3.893e+09	
Corporate social responsibility policy	3.189e+09	6.913e+08	4.61	0	1.759e+09	4.619e+09	***
Employee performance evaluation	1.428e+09	1.039e+09	1.37	.182	-7.127e+08	3.569e+09	
Health and safety standard certification	1.424e+09	5.981e+08	2.38	.026	1.867e+08	2.661e+09	**
Constant	6.126e+09	3.220e+09	1.90	.07	-5.358e+08	1.279e+10	*
Mean dependent var	693202780.167		SD dependent var		2781870087.372		
R-squared	0.813		Number of obs		86		
F-test	8.349		Prob > F		0.000		
Akaike crit. (AIC)	1632.472		Bayesian crit. (BIC)		1653.058		
*** $p<.01$, ** $p<.05$, * $p<.1$							

Overall, the model is found to be statistically significant at the 1% level of significance (P-value=0.000).

Environmental Policy (1=yes, 0 otherwise): this variable is found to be statistically significant at the 5% level of significance (p-value=.038). This suggests that companies with an environmental policy are more profitable than those without one.

Environmental management system certification (1=yes, 0 otherwise): this variable is also significant at the 10% level of significance (p-value=0.062). The companies

surveyed show that gross profit increases with environmental management system certification compared with those without it.

Corporate social responsibility policy: CSR is also highly statistically significant and positively associated with companies' gross profit.

Health and safety standard certification: the variable is positive and statistically significant; it increases the profitability of companies under consideration.

CHAPTER FIVE

DATA INTERPRETATION AND DISCUSSION

5.1. Introduction

This chapter presents a discussion of the descriptive results, the drivers and barriers influencing sustainable supply chain management practices, the quantitative results relating to environmental sustainability indicators, and the determinants of sustainable supply chain performance. Moreover, interpretation of the findings, their implication, and comparison with the existing literature are presented.

5.2. Discussion on the Descriptive Results

5.2.1 Environmental Policy and Management System

Environmental policies in a sustainable supply chain aim to reduce the environmental impact of a product's lifecycle, from raw material extraction to disposal, by integrating various policies such as reducing greenhouse gas emissions, minimising waste, optimising transportation logistics, and prioritising the use of recyclable and renewable materials throughout the supply chain (Wu *et al.*, 2024; Tsoufas & Pappis, 2006; Handfield *et al.*, 2005).

Key aspects of environmental policies in a sustainable supply chain that this study focused on are the following: Environmental Management System (EMS), Sustainable sourcing, energy efficiency, waste reduction, water conservation, carbon accounting and reporting, and supplier sustainability. The following paragraphs discuss the key aspects of environmental policies in a sustainable supply chain as implemented within the manufacturing firms included in the study.

As shown in Figure 6, the finding shows that manufacturers have company-level environmental policy/manual in place to implement and measure the environmental policy, regularly appraise performance, and make enhancements. This finding implies that the Ethiopian manufacturers are conscious of environmental sustainability practices, which is a good first step toward overall sustainability.

Manufacturers were also questioned on who the responsible body for the environmental issues would be; accordingly, the response shows (see Figure 7) that 35% of the manufacturers have their own separate department responsible for the environmental policy, 27% of manufacturers said the CEO is responsible, and 20% of manufacturers assigned this responsibility to the production department. The finding shows that 35% of manufacturers have given strong emphasis to supply chain sustainability practices by assigning a designated position in charge.

Manufacturers were also asked how frequently they monitor and evaluate their company's environmental performance. As shown in Figure 8, most responses indicate that these manufacturers monitor and evaluate their environmental policies annually, every 3 months, and every 9 months. The variation in the frequency with which companies monitor and evaluate their environmental performance is acceptable, as several factors, including company size, legal obligations, and specific sustainability goals, dictate the appropriate intervals for assessing environmental performance in the supply chain.

The important implication exposed in this finding is that most of the manufacturers included in this study whether it be annually, every three months, or every nine months, made it clear their monitoring and evaluation are sufficient to ensure that the environmental performance is on track, and that problems related to it are noticed early, and the firm continues to meet regulatory obligations and sustainability goals. This, however, represents the respondents' perspective and does not definitively validate the real efficacy of these procedures.

However, the finding revealed that a significant number of manufacturers (18.9% of 86 manufacturers) do not regularly monitor or evaluate their environmental performance in the supply chain. This is a serious problem that may lead to several negative consequences. This is especially true for industries like manufacturing, with significant environmental impacts, where failing to regularly monitor and evaluate their environmental performance would risk their existence. Without periodic monitoring and evaluation, manufacturers may fail to meet compliance requirements, leading to environmental harm, fines, and legal consequences. Moreover, the firms could miss opportunities to reduce operational costs through more sustainable practices and face reputational damage. Some respondents (5.41% of 86 manufacturers) chose the "Other" option when specifying their monitoring frequency. Subsequent clarification indicated that these manufacturers generally assess their environmental performance on an ad hoc basis, primarily in reaction to external factors such as governmental audits or complaints from regulatory agencies.

In general, a company's long-term survival and capacity to satisfy future sustainability standards may be at risk if environmental performance in supply chain assessments is neglected (L'Abbate

et al., 2018; Carvalho *et al.*, 2018; Mardani *et al.*, 2020). Therefore, the manufacturers should have a system or policy to monitor and evaluate environmental performance in the supply chain.

Environmental risk assessment is the process of monitoring and assessing the possible adverse effects of human activities, chemicals or natural events on the environment. It enables policymakers, business and regulatory bodies to make well-informed decisions to reduce environmental harm (M. Xu *et al.*, 2019; Munir *et al.*, 2020). Environmental risk parameters related to sustainable supply chains include greenhouse gas emissions, energy consumption, pollution, toxic chemicals that can harm water, human populations, and wildlife, non-compliance with sustainability laws, and other natural disasters. These parameters are mainly driven by manufacturers' actions and/or inaction, or by their suppliers' (Munir *et al.*, 2020). The manufacturers are directly responsible for controlling or mitigating these environmental risks (Environmental Standards for Industrial Pollution Control in Ethiopia, 2008).

Furthermore, manufacturers were asked how frequently they assess environmental risks in their sustainable supply chains. Hence, this study shows that most manufacturers annually assess environmental risks associated with their supply chains. This is a good demonstration that manufacturers are keen to assess and mitigate environmental risks associated with their manufacturing. Assessing environmental risks at appropriate time intervals for each manufacturing process is required under Ethiopian environmental law (Jacobs, 2020; Environmental Standards for Industrial Pollution Control in Ethiopia, 2008).

The manufacturers were asked whether their company has set clear objectives and targets to increase energy efficiency. The finding shows (see Figure 10) that 80% of the surveyed manufacturers have established energy-efficiency targets as an integral part of their sustainability and cost-reduction plans. These targets are generally focused on decreasing energy usage, minimising operational expenses, enhancing environmental performance, and meeting regulatory requirements and customer demands (Ortas *et al.*, 2014a; Bunclark & Barcellos-Paula, 2021). By setting these objectives, manufacturers can achieve their sustainability goals, a good practice that every manufacturer should possess. Setting energy-efficiency targets is becoming standard practice in modern manufacturing operations (Liu & Bae, 2018).

Figure 11 shows manufacturers' practices regarding reporting GHG emissions to the Carbon Disclosure Project (CDP) or the public. Surprisingly, more than 64% of the manufacturers studied reported not having a practice of reporting their GHG inventory to the CDP or the public. The companies were asked why they failed to report GHG emissions to CDP or the public; some manufacturers said they lacked the knowledge or framework to effectively manage and disclose GHG emissions. This is due to a shortage of qualified staff, the absence of dedicated sustainability teams, or inadequate data management systems.

The findings reveal that manufacturers may be concerned that disclosing their emissions could lead to criticism and harm their image, particularly if their emissions are higher or their environmental sustainability practices fall short. Consequently, due to fear of negative publicity, manufacturers are unwilling to disclose their GHG emissions to the relevant bodies. This finding also implies that these manufacturers are not facing significant regulatory demands or pressures to report their emissions, which may lower their likelihood of participating in voluntary programs such as CDP. In the absence of legal obligations or public accountability, manufacturers may choose not to participate in the reporting procedure. This goes to the regulatory bodies' failure to inspect and control these manufacturers' environmental sustainability practices and performance. Here, manufacturers should develop their own reporting standards or follow the CDP-established standards, as adherence to recognised standards enhances credibility and comparability among stakeholders.

Comparing the findings with the previous question, it is found that the manufacturers are good at setting energy use efficiency targets, but they prefer not to make these targets public, as more than 64% of the manufacturers in this study do not disclose them (see Figure 12), despite the potential advantages that transparency can bring. The hesitation of most manufacturers is the risk of underachievement. If these manufacturers disclose their energy-use reduction targets to the public and fail to meet them, they could fear reputational damage. Previous researchers Rodríguez-Sinobas *et al.* (2018), Bunclark & Barcellos-Paula (2021)) Lewellyn & Logsdon (2017) also proved that public transparency heightens external examination from stakeholders such as customers, investors, and regulators. Organisations might find it challenging to meet the heightened expectations for achieving those objectives, particularly if accomplishing them requires substantial adjustments or significant financial commitments. In contrast, manufacturers should understand that publicly setting energy reduction targets will enhance top management

and employees' commitment to achieving them and boost the firm's credibility and public acceptance.

5.2.2 Sustainability Supply Chain Management Process and the Environment

Environmental collaboration refers to an organisation's active engagement with its suppliers and customers to jointly strategize environmental management and solutions. This collaboration focuses on the relationship between a manufacturer and its suppliers and/or customers. Environmental collaboration involves sharing technical information and requires a commitment to understanding each other's operations to plan and establish goals for environmental enhancement. It also entails working together to mitigate the environmental impacts of material flows within the supply chain. Ultimately, effective environmental collaboration requires a clear understanding of each participant's responsibilities and capabilities in environmental management.

Environmental collaboration helps to have a sustainable supply chain system that involves collaborating with customers on sharing sustainability information, on green and cleaner production processes, on green packaging, convincing customers to purchase eco-friendly materials, to use less energy while transporting and reducing carbon emissions by using fuel-efficient vehicles and/or by optimising delivery routes. It also involves collaborating with suppliers to minimise energy use in transporting raw materials, jointly setting and achieving environmental objectives, and, finally, enabling manufacturers to critically evaluate, select, and work with suppliers that are environmentally certified. The contractual agreement among manufacturers, suppliers and customers to have a strong environmental collaboration also includes the level of consideration by all parties for reduced consumption of material energy while designing a product, their level of consideration for products that can be reused, recycled, and recovered of its components, their level of consideration for products to reduce the use of harmful/toxic material, their level of consideration for optimisation of design process to reduce air emission and noise, and their level of consideration for optimisation of design process to reduce solid and liquid waste.

Manufacturers in this study were asked a list of questions to assess the level of collaboration with their suppliers and customers in implementing sustainability practices across their entire supply chain.

According to the results displayed in Table 11, the mean and standard deviation values are based on responses measured using a Likert scale (e.g., 1 = low level of consideration / strongly disagree, 2 = moderate level, 3 = high level, etc.). The mean represents the average level of consideration or agreement among respondents, while the standard deviation indicates the degree of variation in responses. Accordingly, the descriptive results, level of consideration for products to reduce use of harmful/toxic material (2.628) has the highest mean, followed by level of consideration for optimisation of design process to reduce solid and liquid waste (2.488), level of consideration for optimisation of design process to reduce air emission and noise (2.465), level of consideration to purchase eco-friendly materials (2.326), and level of consideration for products that can be reused, recycled, and recovered of its components (2.233). Hence, the results indicate that manufacturers have moderate performance in consciously incorporating environmental considerations into their supply chain operations.

A strong collaborative environment among all supply chain members would help manufacturers minimise the environmental impact of unsustainable sourcing of raw materials, unsustainable product manufacturing processes, unsustainable product packaging, and unsustainable distribution or transportation of goods. Besides, such successful collaboration can positively influence both manufacturing and environmental performance. Therefore, all supply chain actors should prioritise establishing and maintaining a strong environmental collaboration among them.

5.2.3 Social Dimensions Practices

The social aspect has been established to assess the well-being of employees, customers, and the community affected by a manufacturing company's activities and products. It categorises this dimension into three primary subdivisions:

- Employee (which includes employee well-being concerning health, safety, security, career advancement, and job satisfaction within a manufacturing setting),
- Customer (which pertains to customer well-being in relation to health and safety, as impacted by manufacturing and its products), and
- Community (which encompasses community well-being, including health, safety, and human rights, affected by manufacturing activities and the products created). (Eslami *et al.*, 2019)

According to the scope of this study, the social sustainability aspect focused on the well-being of employees and the community. The social sustainability dimension of this study includes

Occupational Health and Safety Standard Certification, community engagement, human resource practices, the existence of trade unions, and corporate social responsibility.

5.2.3.1 Corporate Social Responsibility (CSR)

CSR management practices consist of two components: internal staff and external communities. CSR practices aimed at internal stakeholders (such as employee safety and working conditions) and external stakeholders (such as the community and customers) can enhance a company's social reputation and overall social performance. The Resource-Based View (RBV) can be applied to social sustainability in the supply chain; therefore, RBV was employed in this study to explain the relationship between corporate social responsibility and firm performance. Manufacturers can enhance their social sustainability by leveraging resources such as corporate reputation, stakeholder relationships, employee competencies, and organisational culture. These resources hold significant value and can set a company apart by showcasing its dedication to social initiatives (e.g., fair compensation, employee welfare programs) (Cek & Ercantan, 2023). RBV and social sustainability are linked through the perspective of resources and capabilities that companies can deploy to build competitive advantage while maintaining responsible, ethical practices in their supply chains. By cultivating and utilising these resources, companies not only improve their competitive position but also increase their profits. Based on the Institutional Theory, social motivations are an additional factor driving businesses to focus more on sustainability issues. This has encouraged the implementation of more friendly manufacturing practices (Cek & Ercantan, 2023; Eslami *et al.*, 2019).

According to results from Ethiopian manufacturing firms, most (90%) of the manufacturers have a formal corporate social responsibility policy in place (see Figure 13). This finding indicates that the manufacturers are giving back to society.

Consequently, the implementation of internal socially responsible management practices positively influences a company's social performance. The existence of a corporate social responsibility policy and profit are positively related, indicating that those with the policy are likely to achieve profit.

5.2.3.2 Community Engagement Practices

Four items were used to assess the community engagement of the manufacturing firms of this study; these are job and training opportunities to the local community (apprenticeships or work experience), open dialogue with the local community on environmental and social issues, financial support to local community development activities, and Company employees' participation in societal volunteer activities. This community engagement reflects the manufacturing firm's contribution to the communities where it operates.

The results (Figure 14) indicate that financial contributions to local community development initiatives score the highest mean of 4.03 compared to other community engagement activities by manufacturing firms. These firms significantly impact the local and broader communities. They do this by opening educational institutions, establishing medical facilities, providing access to clean water through free community water stations installed outside their buildings, and supporting various youth-focused sports clubs, among other initiatives.

Additionally, manufacturing firms play a vital role in creating employment opportunities for local residents. They are committed to offering apprenticeships to anyone who needs them, fulfilling their responsibility to collaborate with Ethiopian universities and colleges by accepting students for internships and providing them with practical work experiences. Furthermore, they permit researchers to utilise their resources, including both primary and secondary data. Hence, it can be concluded that the manufacturing supply chain sustainability practices often extend beyond the factory floor, as they invest in projects aimed at improving the welfare of the community, and this has a positive impact on the firm's overall sustainability performance in support of previous findings (Yu *et al.*, 2023). This indicates that Ethiopian manufacturing companies demonstrate strong socially sustainable performance.

5.2.3.3 Occupational Health and Safety Standard Certification

Occupational injuries present a worldwide issue resulting potentially in permanent disabilities and fatalities among workers in the manufacturing sector. The industrial workforce faces numerous occupational risks globally. In addition, both individual health and safety and the overall effectiveness of organisations are affected by occupational hazards (Debela *et al.*, 2023; Abera *et al.*, 2017). Consequently, manufacturers are attracted to adopting the ISO 45001 standard, which addresses Occupational Health and Safety (hereafter referred to as OH&S). ISO 45001, the standard for occupational health and safety management systems, enables

organisations to create safe and healthy work environments by minimising the risks of work-related injuries and staff absenteeism. Implementing OH&S also fosters a culture of trust, empowers employees, enhances the organisation's social performance, and reinforces compliance with regulatory and industry standards. Ethiopian manufacturers are adopting an OH&S standard to improve their performance, reduce work-related injuries, and protect their reputation.

Similarly, in the context of Ethiopia, the Ethiopian Labour Proclamation mandates that employers have a legal duty to safeguard employees from injuries and illnesses, including the provision of occupational health services (Debela *et al.*, 2023).

Among the theories on which the sustainable supply chain is grounded, the Institutional theory is most closely related to OH&S. It examines how institutions, such as laws, norms, and regulations, shape the actions and practices of organisations and individuals. It emphasises the significance of social frameworks and how organisations align themselves with societal norms to secure legitimacy and stability.

In the context of OH&S standards, institutional theory helps explain how organisations implement OH&S regulations and practices to retain and attract key personnel. Besides, this relationship can be revealed when manufacturers implement OH&S standards primarily to gain legitimacy in the eyes of external stakeholders such as governments, labour unions, and the public, and to reflect societal norms and expectations. The institutional theory also describes how organisations operating within a particular sector or geographic area often align their practices over time, through isomorphism. Isomorphism can appear in occupational health and safety practices when organisations replicate the actions of their peers or rivals, or when they conform to industry standards to prevent being viewed as exceptions (Viswanathan *et al.*, 2024).

Prior studies argue that implementing OH&S standards results in reduced workplace accidents, decreased disruptions in production flow, minimised wasted resources, and reduction of the most critical injuries and illnesses that result in absence from work. As a result, this implementation can enhance financial performance by boosting operational efficiency. When employees experience safety and maintain good health, they are more likely to be motivated and perform better at their jobs. Greater satisfaction with their working environment and enhanced employee well-being can directly contribute to improved workplace productivity. (Badri Ahmadi. *et al.*, 2017 and Yang & Maresova, 2020). Manufacturers were asked whether they are certified to

Occupational Health & Safety Standards (ISO 45001). Figure 15 demonstrates the manufacturers' responses accordingly, 44% of manufacturers are certified to OH&S, whereas 56% reported that they are not.

According to this study's findings, some Ethiopian manufacturers are adopting an OH&S standard to enhance performance, reduce work-related injuries, protect their reputation, and increase profits, and they are achieving their aims. Hence, appreciating those manufacturers that already adopt OH&S standards, it is recommended that all manufacturers place strong emphasis on the health and well-being of employees to enhance organisational endurance through an internationally recognised occupational health and safety management system.

5.2.3.4 Human Resource Practice

Human resource practice is another aspect of the social dimension related to employees' well-being. Five items were used to assess the human resource practices of the manufacturing firms in this study. The results (see Table 12) show that manufacturing firms have appropriate human resource policies and practices that support employee well-being. Manufacturing firms are implementing and managing their human resources in accordance with the Ethiopian Labour Proclamation 1156-2019.

5.2.3.5 Trade Union

Trade unions are organisations formed by employees to safeguard and advance their interests and are one of the main social dimensions. These unions negotiate with employers on behalf of their members to secure improved working conditions, salaries, benefits, job security, and workers' rights. Trade unions are crucial in promoting equitable labour practices and social justice in the workplace (Jabbour & De Sousa Jabbour, 2016).

When managers and employees work together through legally required workplace organisations, such as trade unions, workers can express their concerns about working conditions and offer ideas for improving operational processes, thereby contributing to decisions on workplace safety and health and enhancing working environments. Furthermore, these workplace organisations are more effective when supported by fundamental labour rights, such as freedom of association and collective bargaining, as exercised by trade unions (Kuruvilla & Li, 2021).

According to the results (see Table 13), a significant number of manufacturers responded that they do not have formal trade unions in their companies. This is a serious problem that signals a

violation of basic rights to freedom, and the collective bargaining power of their employees might be neglected. The lack of trade unions and freedom of association can lead to the disregard of employees' well-being and fundamental labour rights. Consequently, it is advised that manufacturing companies acknowledge trade unions as a means to promote social sustainability. Additionally, this recognition is a fundamental labour right that enables employees to exercise their right to collective bargaining. Therefore, management should permit and encourage the formation of such employee associations for their mutual advantage.

5.2.4 Supplier Integration

In this study, manufacturers were assessed on the level of integration they have with their suppliers. The result shows (see Table 14) manufacturers' responses regarding their relationship with their suppliers, the buyer-supplier relationship. The issues are summarised under the supply integration category, with due emphasis on suppliers' environmental sustainability. So, the variables with high and medium mean values will be analysed and discussed. As vividly shown in Table 13, the company works only with certified suppliers, which is the most important variable with a 3.849 mean score in the supplier integration category, followed by the company's demand that suppliers sign a code of conduct as a prerequisite for working together with a 3.698 mean score. This finding demonstrates the manufacturers' keen interest and early engagement with environmentally conscious suppliers from the outset. Therefore, manufacturers must maintain and enhance their integration with suppliers to obtain the maximum benefits from their environmental sustainability processes. The manufacturers should establish, maintain, and value long-term relationships with their suppliers if the integration is advantageous for both parties. It is believed that, in long-term buyer-supplier relationships, risks are lower.

It has been suggested that a company can improve its performance by fostering a consistent exchange of information, trust, resources, knowledge, skills, and investments with external partners. This theory emphasises that organisations can gain a competitive edge by collaborating in networks or partnerships. The Resource View (RV) theory is crucial for understanding the need for firms to increase their Supply Chain Integration (SCI) levels. This lays a solid foundation for exploring how Sustainable Supply Chain Performance (SSCP) can be enhanced from an SCI perspective. Consequently, it is reasonable to anticipate that companies with global supply chains, such as those in the food manufacturing sector, can achieve high SSCP by

regularly sharing information, skills, trust, processes, and resources among partners throughout the supply chain. Furthermore, this theory can be applied to investigate the role of SCI in enhancing SSCP, once a culture that supports sustainability is established. This suggests that the culture within food manufacturing firms is likely to bolster integration practices by coordinating the necessary resources, skills, tacit knowledge, data, and information to enhance SSCP across the supply chain. Therefore, it is expected that a supportive culture will improve SCI among partners in the global food supply chain and, in doing so, enhance collaboration on the resources, skills, knowledge, and information required to achieve higher SSCP levels. Based on this theory, it can be concluded that, even with a culture that fosters sustainability, food supply chains still need to strengthen their integration efforts to achieve higher sustainability performance outcomes (Dyer *et al.*, 2018).

As mentioned by previous scholars like Himanen & Martikainen (2019), Fernández (2015) they argues that a company's adverse environmental impact is also highly determined by its suppliers' environmental behaviour. If manufacturers need to prosper in manufacturing sustainably, they must require all their suppliers to do so (Govindan *et al.*, 2014). To sustain sustainability across their supply base, manufacturers can adopt sustainable supply chain initiatives that incorporate sustainability considerations into supplier selection, assessment, and integration (Muñoz-Torres *et al.*, 2021; Fernández, 2015). Hence, the first action manufacturers should take is to create a healthy buyer-supplier relationship. In doing so, manufacturers should have a robust standard for selecting and monitoring potential suppliers.

To sum up, the findings show that sustainable supply chain practices adoption is increasing in Ethiopian manufacturing, but it is uneven and fragmented. The findings further indicate that export-oriented manufacturing firms have implemented sustainable supply chain practices largely in response to external pressures, including regulatory requirements, customer expectations, and international market standards. In contrast, firms serving primarily domestic markets demonstrated lower levels of sustainable supply chain practice adoption and weaker sustainability performance, largely due to limited government enforcement and reduced pressure from other external stakeholders.

5.3. Discussion on Drivers and Barriers of Sustainable Supply Chain Practice

5.3.1 Drivers of Sustainable Supply Chain Practice

SSCM drivers are pressures, triggers, and enablers that demand a firm to adopt/implement sustainable practices/ initiatives across its supply chain. Usually, the pressure emanates from internal and external stakeholders (Hsu *et al.*, 2013). Hence, the factor analysis identified seven key factors driving the adoption of sustainable supply chain practices in Ethiopia's manufacturing sector. Two of these factors (government regulatory factors and customers) are classified as external driving forces, while the remaining five (Top management commitment, Operational performance, Profitability, Productivity, Employees, and Company Size) represent internal influencing factors.

According to Institutional Theory, coercive factors are identified as a significant aspect in applying pressure for the adoption of sustainable supply chain practices. They refer to the influence imposed by authoritative entities, such as governments. Across the globe, governments have formulated and enacted regulations concerning environmental and social matters (Esfahbodi *et al.*, 2017b; Gimenez & Sierra, 2013; Park *et al.*, 2004; Zhu *et al.*, 2013; Saeed *et al.*, 2017).

Governmental regulatory pressures exist in the form of standards, laws, procedures, and incentives set by regulatory institutions to promote sustainability practices and are imposed by the government and regulatory bodies, trade associations, and other international and national institutions (Hsu *et al.*, 2013). According to Schrette *et al.* (2014) and Beamon (1999) legislations have a strong outcome in creating awareness and influencing firms to implement sustainability practices, and the imposition of legislation can differ from one nation to another (Zhu *et al.*, 2013). In 2001, Japan implemented the Japanese Law on Promoting Green Purchasing, requiring firms to purchase from environmentally friendly suppliers (JCPRA, 2020). The Occupational Health and Safety Act (OHSA) in Canada defined labour standards and duties for employers, owners, and suppliers in 1985 (Codification, 2011).

Table 23 below lists the main drivers of sustainable supply chain practices among large and medium-sized manufacturing firms in Ethiopia.

Table 23 Driver of Sustainable Supply Chain Practice

Variable	Factor1	Factor2	Factor3	Factor4	Uniqueness
Government regulatory factors	0.6650				0.6360
Company Geographical location					0.5616
International regulatory factors					0.5037
Professional associations		0.6486			0.3843
Certification as a regulatory factor					0.6813
Financial incentives from the government					0.6894
Competitive advantage				0.9589	0.0000
Expectations from shareholders					0.7233
Competitors' sustainability practices					0.2636
Customer	0.6162				0.4346
Company image and reputation					0.3527
Globalisation					0.9378
Local inhabitants (public)		0.7134			0.4872
Media		0.7771			0.2797
NGO working in sustainability		0.8823			0.3494
Consumer associations		0.6346			0.5386
Top management commitment	0.6699				0.5192
Operational performance	0.8510				0.2145
Reduce the environmental impact.					0.5402
Profitability and productivity	0.7265				0.3283
Sociocultural responsibility		0.7358			0.4051
Business ethics					0.4993
Health issues			0.9777		0.0000
Resource depletion			0.7425		0.2341
Employees	0.6148				0.4140
Better workplace environment					0.2747
Company Size	0.6995				0.4514

According to the findings of this study through factor analysis, the main (factor1) internal driving factors (see Figure 20) to implement SSCM in manufacturing industries in Ethiopia are top management commitment, operational performance, profitability, productivity, employees, and company Size. Government regulatory factors and customers (see figure 20) are also the top two external drivers (factor1) for adopting SSCM practices in the Ethiopian manufacturing industry.

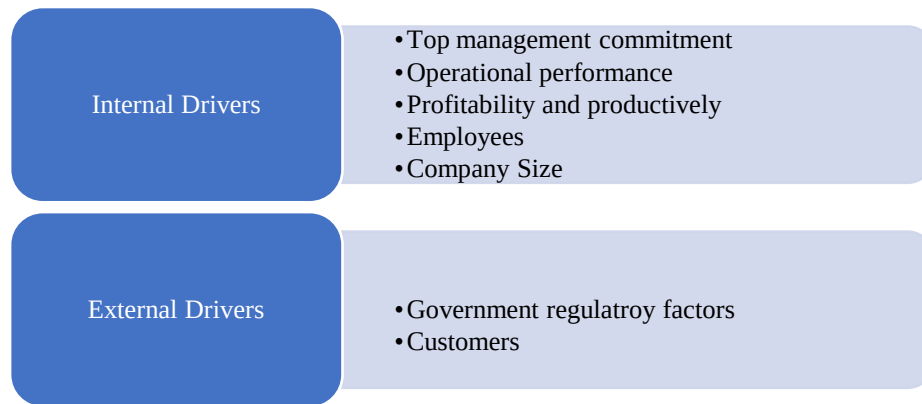


Figure 20 Main Drivers (Factor 1) of Sustainable Supply Chain Practice

Ethiopia has also established policies and laws that manufacturers must follow; for example, it encourages and assists manufacturing enterprises in implementing/achieving EMS and ISO 5000 standards, and it has established an eco-labelling law for manufactured products, with a vision of becoming a middle-income country through green manufacturing ; Federal Democratic Republic of Ethiopia National Logistics Strategy, 2018; Environmental Standards for Industrial Pollution Control in Ethiopia, 2008; Jacobs, 2020).

International standards and guidelines like the International Organisation for Standardisation (ISO) and the Occupational Health and Safety Assessment Series (OHSAS) encourage firms to implement sustainability (Beamon, 1999). Firms are also influenced by financial incentives from external organisations, like tax exemptions; moreover, some firms act proactively in practising sustainability as part of their corporate social responsibility (Moretto *et al.*, 2018; Caniato *et al.*, 2012).

The results (see Table 24) revealed that increased governmental regulatory pressure on the Ethiopian manufacturing sector typically enhances the implementation of sustainable practices in this sector. This is exactly consistent with the findings of previous studies such as Govindan *et al.* (2020) and Mathivathanan *et al.* (2018). Coercive pressures directly affect all SSCM practices. Overall, coercive pressures are identified as major motivators for manufacturers to pursue SSCM practices, highlighting the importance of governance in the adoption of an SSCM agenda (Baliga *et al.*, 2019; Balda & Singh, 2022; Campbell, 2007; Emamisaleh & Taimouri, 2021). In addition to governmental regulatory factors, this research has found that customers are the primary external factor motivating Ethiopian manufacturing firms to adopt sustainable supply chain practices across their entire supply chains.

The most crucial element of every business is its customers. To guarantee customer satisfaction and the firm's survival, businesses frequently devote significant attention to meeting their clients' needs. Customers are the foundation of any business; they can exert external pressure on the firm to adopt any initiative they value most. The findings of this study are consistent with the findings of others like Paulraj *et al.* (2017) and Alzawawi (2014) The major external variable affecting the integration of sustainable practices into supply chain operations is customer pressure.

Customer requests for green products and services are regarded as one of the most significant drivers for sustainable supply chain practices, as proved by the works of Alzawawi (2014) Walker *et al.* (2007) Saeed and Kersten (2019) Menke *et al.* (2021) and Schonebeck and Pöllinger (2020). Recently, customers have become more aware of the harmful environmental impacts caused by the manufacturing sector. Hence, it can be concluded that the customers put high pressure on firms to create sustainable supply chains to reduce the environmental damage they cause (Menke *et al.*, 2021; Gong *et al.*, 2019; Eze *et al.*, 2018).

Since the majority of Ethiopian manufacturing companies in Industrial Parks export to customers in the United States, Europe, and Asia, they are under pressure to demonstrate that their supply chains are sustainable. According to interviews, these customers prioritised the following Supply chain sustainability features: no child labour, recycling (businesses must demonstrate that their waste is recycled and reused by other small businesses in the area), reduced environmental impact, and worker health and safety, among others.

There is a consensus among previous researchers such as Niemann *et al.* (2016) and Tseng *et al.* (2022). Customers not only need high-quality products but also want them to be environmentally friendly when making buying decisions. This drives the manufacturing firms to implement sustainable supply chain initiatives, and it has an impact on the entire manufacturing firm's supply chain process, from design to the end-of-life of the product (Menke *et al.*, 2021).

Top management commitment is identified as a key motivating element for the adoption of a sustainable supply chain in the Ethiopian manufacturing companies included in the study, based on the findings of the Factor Analysis displayed in the above table (see Table 24). This study shows that senior management's commitment to strategically integrating sustainability initiatives is a necessary condition for achieving the organisation's sustainability goals.

Understanding stakeholder pressures related to sustainability is an essential task of top management, as it drives the adoption of sustainable practices both inside the company and

throughout the supply chain network (Xu *et al.*, 2013). Achieving sustainability across the supply chain becomes the top priority if the organisation's top management is convinced of the potential benefits (Schrettle *et al.*, 2014). This is because top management oversees establishing the organisation's vision and policies and informing its employees of them. As a result, getting top management support is seen as a crucial first step toward supply chain sustainability (Hsu *et al.*, 2013). While top management develops corporate strategy and integrates sustainability-related goals into the strategy, consumers' awareness of sustainability and desire to purchase sustainable products can motivate organisations to adopt a sustainable corporate strategy (Haverkamp & Bremmers, 2010). The organisation's strategy serves as a bridge between the internal and external realms, assisting in the alignment of internal resources and external demands in order to accomplish SSCM objectives (Strategy, 2010). By addressing sustainability-related concerns and implementing sustainable practices, businesses can reduce expenses by conserving resources like energy, water, and materials. Consequently, businesses boost their profitability and enhance their sustainability performance (Redekop *et al.*, 2018). Lower expenses, improved customer satisfaction and company reputation, and increased revenue as a result of implementing sustainable practices result in better (Caniato *et al.*, 2012).

Studies such as Haldorai and Kim (2024) and Burki and Ersoy (2019) all concluded that top management has a critical role in managing and implementing sustainable supply chain practices. When senior management recognises the benefits of addressing sustainability issues, they will desire to implement all sustainability initiatives that lead to better environmental, social, and economic performance (Burki & Ersoy, 2019).

Workers can exert internal pressure on manufacturers to implement sustainable practices by acting alone or through their unions (Saeed & Kersten, 2019). Hence, employees have been regarded as one of the primary internal drivers of implementing sustainability practices, as shown in previously conducted studies, such as those by Zhu *et al.*, (2013), and this study has confirmed this as well. According to this study, employees were the main factor influencing manufacturers' sustainability practices. Employees can pressure manufacturers to incorporate sustainable supply chain initiatives to improve their company's sustainability performance and reduce the number of job-related health and safety incidents that the employees may experience (Burki & Ersoy, 2019; Asif *et al.*, 2020). Sustainability is becoming a critical factor in employees' decisions to choose and stay with a given business organisation. Some reports, such as reports

from World Economic Forum, (2020), Bai *et al.*, (2020), confirm that 70% of workers would prefer to work at a company with a solid environmental sustainability program. So, sustainability is becoming a critical factor in employees' decisions to choose and stay with a given business organisation (Bai *et al.*, 2020).

5.3.2 Barriers to Sustainable Supply Chain Practice

Among the main objectives of this study, identifying the various barriers that hinder the proper implementation of sustainable supply chain practices in the Ethiopian manufacturing sector was the most important. To that end, by properly identifying the barriers, manufacturers or their policymakers at different levels can plan a strategic mitigation approach to overcome them.

As a continuation of the above discussion (drivers of sustainable supply chain management, see table 23), table 24 lists the main barriers to sustainable supply chain practices in the large and medium-sized manufacturing firms in Ethiopia.

Table 24 Barriers to Sustainable Supply Chain Practice

Factors	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8	Factor9	Factor10	Uniqueness
Absence of government policies and incentives											0.3711
Cost of sustainable supply chain implementation				0.9592							0.1438
Cost of environmentally friendly raw materials				0.8121							0.1738
Absence of organisational strategy for sustainability	0.8188										0.0000
Absence of the ability to engage in sustainable practice	0.9645										0.0000
Inadequate commitment by top management			0.9110								0.0000
Absence of employee motivation in adopting SSCM											0.2441
Unnecessary Organisational Bureaucracy						0.8991					0.0000
Absence of knowledge and training		0.8956									0.0000
Absence of customer serious demand for sustainable products/solutions					0.9108						0.0000
Reluctance of customers to share costs											0.5191
Absence of customer awareness about sustainability							1.0058				0.1738
Absence of societal awareness about sustainability											0.4019
Unwillingness from suppliers to collaborate and/or share information									0.9506		0.2047
Insufficient regulatory requirements											0.4863

Hence, according to Factor analysis results (see Figure 21), absence of ability to engage in sustainable practice and the absence of organisational strategy for sustainability are identified as Factor1 (main) barriers, the absence of knowledge and training as Factor 2, Inadequate commitment by top management Factor3, and Cost of sustainable supply chain implementation and Cost of environmentally friendly raw materials as Factor 4.

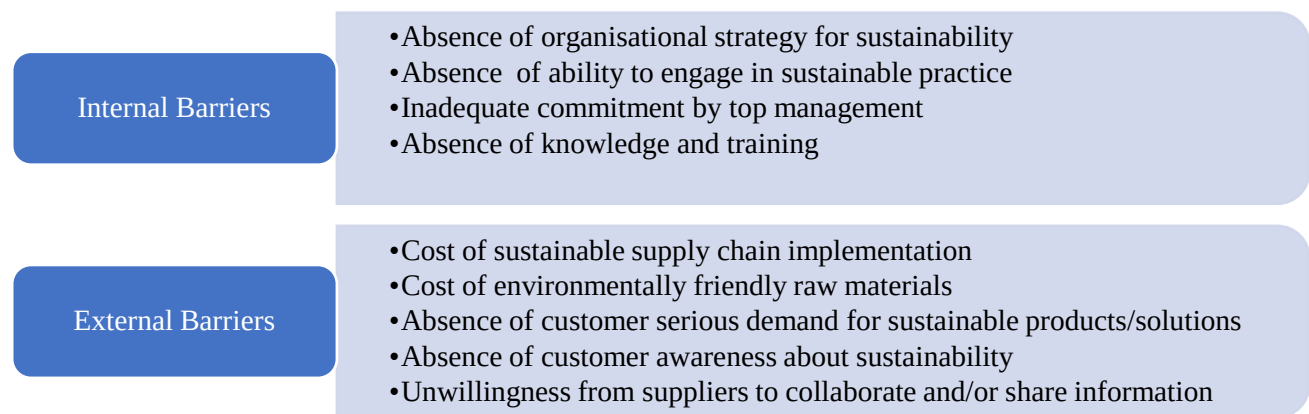


Figure 21 Main Barriers to Sustainable Supply Chain Practice

Among the major barrier factors identified by Factor analysis, ‘absence of ability to engage in sustainable practices’ was found to be the most important impediment to sustainable supply chain implementation in the Ethiopian manufacturing sector. Manufacturing firms often lack the technical knowledge and expertise to implement sustainability practices in their supply chains. This is because either the right person is not available for the task, or that person does not have the required education and experience. Gupta *et al.* (2020a,) Govindan *et al.* (2014), Karuppiah *et al.* (2020) in line with prior studies by Narayanan *et al.* (2019a) Hariyani *et al.* (2022) Aziz Khan *et al.* (2024) Kalpande and Toke (2021), also affirm that the inability to engage in sustainable practices indicates low employee commitment to sustainable supply chain practices. This can be due to poor understanding or awareness, insufficient knowledge and education, and inadequate training. All these factors could impact employees’ motivation, commitment, excitement, and satisfaction in adopting the sustainability practices (Narayanan *et al.*, 2019b; Tay *et al.*, 2015).

The barrier identified as ‘Absence of ability to engage in sustainable practices’ shows low employee commitment to willingly engage in the sustainable supply chain practices. This can still be due to poor understanding or awareness, poor knowledge and education, and the absence of adequate training; all these factors have a severe impact on employees’ motivation, commitment, and excitement, for adopting the sustainability practices (Aziz Khan *et al.*, 2024; Zayed & Yaseen, 2021).

In general, the absence of employees’ ability to engage in sustainable practices is caused by another barrier identified by Factor Analysis as the second most important factor, which is ‘Absence of knowledge and training’. Hence, the study found that employees' lack of awareness, knowledge, and education regarding sustainability practices and the potential environmental impacts of unsustainable practices affects their commitment to achieving sustainable manufacturing. This finding is consistent with previous findings, which concluded similarly (Hariyani *et al.*, 2022, Baig *et al.*, 2020a, Narimissa *et al.*, 2020; Rahman *et al.*, 2020). This implies that manufacturers should be willing and capable of hiring new employees with appropriate skills and expertise, and/or training and educating existing employees to acquire the necessary competencies.

In continuation of the above discussion, ‘absence of an organisational strategy for sustainability’ has been found as a major barrier to the Ethiopian manufacturing sector’s adoption of sustainable supply chain initiatives. Manufacturing firms should have a clear and well-defined sustainability strategy. However, the finding ‘absence of an organisational strategy for sustainability’ implies that the firms lack direction, a clear vision, and a commitment to sustainability practices, failure to allocate the necessary resources for such a big project, inability to develop measurement standards and goals, which leads to an inability to have periodic monitoring and evaluation policies. Previous research further supports the role that the absence of organisational strategy plays as a major barrier to implementing sustainable manufacturing practices (Hariyani *et al.*, 2022; Gupta *et al.*, 2020b).

Matching with the prior works of Alzawawi (2014) and Zimon *et al.* (2020), this study found that a lack of commitment from top management is a more significant barrier to implementing

sustainable practices in Ethiopian manufacturing. In this study, high commitment from top management has already been identified as a driving factor in the successful implementation of sustainable supply chain practices in the Ethiopian manufacturing sector.

The high cost of raw materials, particularly the high initial implementation cost, and the uncertainty associated with sustainability benefits are reported as hindrances to adopting sustainable supply chain initiatives among the Ethiopian manufacturing firms involved in this study (Baig *et al.*, 2020a). It is believed that these barriers highly contribute to the lack of commitment and motivation that top management exhibits regarding adopting sustainability practices (Tay *et al.*, 2015). Previous studies also support the view that the high cost of implementation, financial constraints, and a lack of top management commitment are major barriers to the successful implementation of sustainable manufacturing practices (Palm & Gustafsson, 2018).

Government and policymakers should prepare awareness and training packages for the top management. This will then positively influence their commitment to sustainability and up-skill them to develop organisational policy and strategy to manage the overall sustainability implementation across their firm. Top management should be convinced that sustainability is not only associated with costs but also brings significant benefits to the firm and the public.

5.4 Discussion of the Quantitative Environmental Sustainability Indicators Result

Evaluating and measuring environmental sustainability in the supply chain requires analysing the ecological effects of the entire process, from acquiring raw materials to delivering the final product. According to Drucker & Maciariello (1999) “What cannot be measured cannot be controlled; what cannot be controlled cannot be managed; what cannot be managed cannot be improved” (Drucker & Maciariello, 1999). Hence, manufacturers should set key performance indicators to evaluate and measure their environmental performance.

The primary quantitative metrics employed by manufacturers include carbon footprint, energy consumption, water consumption, and waste management and recycling. Manufacturers can also use these quantitative measures to set targets for later tracking. By applying these quantitative measures, companies can better understand their environmental sustainability performance

within their supply chain and pinpoint areas that need enhancement (Moldan *et al.*, 2012; Banasik *et al.*, 2018; Ali *et al.*, 2020; Somogyi, 2015; Melkie, 2022).

5.4.1 GHG Emissions

According to the last GHG inventory (2022), total GHG emissions increased from 108 Mt in 1994 to almost 369 Mt, most of them coming from the AFOLU (Agriculture, Forestry, other land Use) sector (335 Mt in 2018 against 12.6 Mt for energy) Verschuuren (2022) and 881.21 Gg CO₂, the industry sector has an average emission growth rate of 20.05% per year (Engdaw, 2020).

CO₂ emissions in Ethiopia in 2022 increased by 2.70% over the previous year, reaching 554,390 tons, up from 20,552,520 tons in 2021. CO₂ emissions per capita in Ethiopia are equivalent to 0.17 tons per person (based on a population of 125,384,287 in 2022), an increase of 0.00 tons over the figure of 0.17 tons per person registered in 2021; this represents a change of 0.0% in CO₂ emissions per capita.

The comparative assessment of key sustainability indicators (as shown in Figure 17 below) across Ethiopian manufacturing sectors reveals significant disparities in energy use, emissions, and technology efficiency. Regarding Energy Consumption, the Textile sector records the highest total energy consumption (51000 MWh), indicating its heavy production intensity and energy dependency. In contrast, the Building and construction and Paper industry sectors consume the least, at 269, MWh and 60 MWh, respectively, reflecting smaller-scale, more energy-conscious operations. Steam use is also highest in the Textile industry (2.7 million MWh), underscoring its reliance on thermal energy for production processes such as dyeing and finishing. The Building and construction again shows the lowest steam usage (488 MWh), consistent with its lower thermal demand.

Pertinent to Carbon Monoxide Emissions, the Building and construction sector generates the highest CO₂ emissions (504,000 metric tons), followed by the Textile sector (235,295 metric tons), both of which are directly linked to fossil fuel-based energy sources. The Energy-Efficient Devices results also show that the Building and construction sector leads in the adoption

of energy-efficient technologies (up to 72.5%), demonstrating strong modernisation and a commitment to sustainability.

5.4.2 Water Management

The 'water footprint' measures the amount of freshwater resources utilised in the production of goods and services. It assesses the volume of water consumed or contaminated. This measurement indicates the specific times and locations of water use, enabling comparisons with the available water resources. The water footprint can evaluate both direct and indirect water consumption by a consumer or producer. Additionally, it is possible to calculate a water footprint for a particular process, product, producer (company), and a nation (Polruang *et al.*, 2018, Skouteris *et al.*, 2018, and Ministry of Foreign Affairs of the Netherlands, 2016).

As shown in Table 26, the average annual water consumption (in Litres) is 61625000, 150000, 2633416667, 24823000, and 250000 for Textile, Clothing and Footwear, Paper Industry, Building and Construction, Food and Beverage, and Automotive, respectively. Furthermore, the annual generated wastewater (in litres) is 1838500, 75000, 552000, 30027200, and 3000000 for Textile, Clothing and Footwear, Paper Industry, Building and Construction, Food and Beverage, and Automotive, respectively.

GHG emissions from various types of industries play a major role in accelerating climate change. Beyond greenhouse gases, wastewater and effluent released by industries can contaminate freshwater sources in surrounding areas (Maco *et al.*, 2018). Effective remediation and management of waste can lower the risks of water resource contamination. In this regard, Table 20 illustrates the manufacturers' quantitative water management indicators.

5.4.3 Waste Management

Previous studies by Ali *et al.* (2020) and Himanen & Martikainen, (2019) identify waste generated from manufacturing processes as a major sustainability challenge in industrial sectors. Additionally, businesses need to manage product demand while minimising material and energy use and reducing waste generation to the greatest extent feasible. Recycling can help in accomplishing these objectives. Table 21 and Figure 20 show the manufacturers' total annual average waste generated and the percentage of waste recycled.

By using these quantitative environmental sustainability metrics and approaches, manufacturers in Ethiopia can monitor and improve their environmental sustainability performance, meet international standards, and support the nation's broader environmental goals. According to its revised NDC (Nationally Determined Contributions) national climate action plans, Ethiopia plans to reduce its GHG emissions by 68.8% (-278 MtCO₂eq) in 2030 compared to a BaU (Business as Usual) scenario, and by 8.8% (-278 MtCO₂eq) with international support (energy, 2025).

5.5 Discussion of the Linear Regression Result

A. Environmental Management System Certification

According to the linear regression results, profit is positively associated with environmental management system certifications. The environmentally certified companies are likely to be more profitable than the manufacturing firms that are not. Moreover, the manufacturing firms' commitment to EMS certification and their adoption and maintenance of environmental initiatives increase their profitability through cost reduction, market differentiation, and regulatory compliance. This finding is consistent with prior studies conducted by Esfahbodi *et al.* (2017b) Touboulic and Walker (2015a) and Wen and Lee (2020) All concluded that manufacturing firms experience a notable improvement in their financial performance and productivity following the acquisition of environmental system certifications. Manufacturers responded that the improved corporate reputation is the most significant benefit of Environmental Management System (EMS) certification, which in turn leads to economic benefits. EMS certification, such as ISO 14001, FSSC 22000, and ISO 50001, demonstrates a firm's commitment to environmental sustainability by embracing practices that lessen undesirable environmental impacts, comply with regulations and international standards, and continually improve environmental performance. EMS certification improves the efficient use of resources like water, energy, and raw materials. Using recyclable materials reduces disposal costs and the risk of fines for non-compliance with environmental standards. All these practices will result in enhanced profitability (Broadbridge *et al.*, 2020).

EMS certifications serve as official recognition that a business or organisation has developed and follows practices and policies to reduce its environmental impact. Authoritative organisations or

regulatory agencies provide these certifications and typically align with established international standards. EMS certifications offer a structured approach for organisations to manage their environmental obligations effectively (Tsoulfas & Pappis, 2006). The most common environmental certifications reported by the manufacturers in this study are shown in Table 25.

Table 25 Common environmental certifications in Ethiopia

Common Environmental Management System Certifications among Ethiopian Manufacturing Industries	Description
ISO 50001 (<i>Energy Management - Systems in Practice</i> , 2002.)	Energy management helps organisations create systems and processes that enhance energy efficiency and minimise energy use.
EMAS (Eco-Management and Audit Scheme) (Mark & Camilleri, 2015)	A European Union program that acknowledges organisations that exceed environmental regulatory requirements and strive for continuous improvements in their environmental performance. It is often regarded as being more extensive than ISO 14001.
Forest Stewardship Council (FSC) (Journal of & Council, 2005)	Certification focuses on products derived from wood and paper, ensuring that these materials originate from sustainably managed forests.
FSSC 22000 (Food Safety System Certification 22000) (<i>FSSC-22000-Scheme-Version-7.Pdf</i> , 2026)	The main objective of FSSC 22000 is to guarantee that food products are safe for consumption by implementing robust food safety management systems throughout the entire food supply chain, from the production of raw materials to the finished product.
ISO 9001 (Neyestani & Juanzon, 2017)	A widely acknowledged standard for Quality Management Systems (QMS) that offers a framework for organisations to consistently provide products and services that fulfil customer and regulatory expectations.

B. Company-Level Environmental Policy

The linear regression results of this study (see Table 22) found a significant, positive relationship between Company-level environmental policy and profit. Manufacturers with a company-level environmental policy are more likely to achieve profitability. Environmental policies in a sustainable supply chain aim to reduce the environmental impact of a product's lifecycle, from raw material extraction to disposal, by integrating various policies such as reducing greenhouse gas emissions, minimising waste, optimising transportation logistics, and prioritising the use of recyclable and renewable materials throughout the supply chain (Broadbridge *et al.*, 2020; Tsoulfas & Pappis, 2006; & Schrettle *et al.*, 2014).

A company's environmental sustainability policy outlines the steps it takes to minimise its environmental impact and ensure sustainable business practices. This can include reducing carbon emissions, minimising waste, using renewable resources, conserving energy, and promoting sustainable sourcing. Such policies often also address social responsibility and community engagement (Esfahbodi *et al.*, 2017b). Establishing and implementing a company-level environmental policy enables manufacturers to comply with government regulations, avoid fines and penalties, and qualify for tax benefits for meeting environmental sustainability requirements. This commitment to environmental sustainability standards can subsequently enhance their profit (Markley & Davis, 2026). Company-level environmental sustainability practices can lower production and material costs, increase resource efficiency, and increase the use of renewable resources, enabling manufacturing firms to reduce operating costs and thereby improve profitability (Cherrafi *et al.*, 2018).

Key aspects of environmental policies in a sustainable supply chain that this study focused on include the following: environmental management system (EMS), Sustainable sourcing, energy efficiency, waste reduction, water conservation, carbon accounting and reporting, and supplier sustainability. These environmental policies improve resource efficiency, thereby directly boosting profitability.

Among the manufacturing firms included in this study, those that have implemented an environmental sustainability policy are more likely to enhance profitability by attracting eco-conscious customers, thereby increasing sales and market share. In addition, this research indicated that environmental policies at the company level, including integrating sustainability practices such as reducing GHG emissions, optimising energy and water use, and minimising waste through recycling, result in improved economic outcomes. The enhanced economic performance in this study is evaluated by increased profits stemming from cost savings or efficiencies, as well as growth in sales and market share.

Previous studies, including Schrettle *et al.* (2014) and Sudusinghe & Seuring, (2020a), support the findings of this study by demonstrating that improvements in sustainability across supply chain stages contribute to enhanced competitiveness and better economic performance, reflected

in new market opportunities, higher product prices, increased profit margins, sales, and market share.

C. Corporate Social Responsibility Policy

The linear regression results of this study, as shown in Table 28, indicate that corporate social responsibility policy and profit are positively related, suggesting that manufacturers with a corporate social responsibility policy are more likely to achieve profit. Viswanathan *et al.*, (2024) argue that companies that enhance employee safety and improve working conditions can boost employee satisfaction, prevent accidents, and ultimately enhance productivity while minimising losses. As a result, it is anticipated that when companies adopt socially responsible management practices, production efficiency will increase. Therefore, internal socially responsible management practices contribute positively to a company's economic performance (Wang & Dai, 2018b). Moreover, this study found that implementing OH&S standards in the Ethiopian manufacturing sector improves financial performance. Those who have implemented OH&S and are certified are likely to achieve higher profits than those without this standard certification. This finding is consistent with the previous findings of (Yang & Maresova, 2020; Viswanathan *et al.*, 2024).

5.6 The Logit Model

Logit and Probit models are appropriate for testing the relationship between dichotomous outcome variables and other sets of independent variables. The general model specification looks like:

$$P(Y = 1|X_i) = \frac{e^{X_i\beta}}{1 + e^{X_i\beta}} \quad (4)$$

Where:

Y is the discrete choice outcome variable;

X_i: the set of explanatory variables;

β-the vector of parameters.

The above equation represents what is known as the (cumulative) logistic distribution function, following (Wooldridge, 2012) and (Gujarati, 2003). The estimation technique for this model is the maximum likelihood estimator (MLE). That is, the parameters are estimated by maximising the likelihood of a given event (the probability function). This model is

applied to the outcome variables of international environmental certification and corporate social responsibility policy.

5.6.1 International Environmental Certification

As an outcome variable, international environmental certification status (certified = 1, 0 otherwise) is regressed using a Logit model. It was tentatively hypothesised that variables such as market share, number of export products, export destination country, sustainability data sharing, and publicly targeted setting, among others, would significantly affect the probability of international environmental certification.

Estimating using the logit model, it is found that the model is statistically significant overall (see Table 26), even at the 1% level of significance (note: Prob > chi2 = 0.00). That means, jointly, that the above-mentioned variables explain the variation in the outcome variable (owning international environmental certification 1=yes, 0 otherwise). When we examine each variable, market share and export destination countries are found to be statistically significant at the 5% and 10% levels, respectively. Market shares are positively associated with holding international environmental certifications. A positive, statistically significant coefficient indicates that a higher market share increases the likelihood of obtaining certification. This suggests that firms with a larger market share may have more resources, obligations and/or incentives to pursue environmental certification. As market share increases, the likelihood of obtaining an international environmental certification increases. Similarly, companies with improved export destinations are highly likely to hold international environmental certifications. The positive, statistically significant coefficient suggests that exporting to certain countries/economies may increase the likelihood of certification, potentially due to stricter environmental standards in those markets.

Table 26 Logistic Regression International Environmental Certification

International Environmental certification DV	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
<i>Market share</i>	1.533	.727	2.11	.035	.107	2.958	**
<i>Number of Export products</i>	.293	1.235	0.24	.812	2.127	2.713	
<i>Export destination country</i>	1.409	.738	1.91	.056	.037	2.855	*

<i>Sustainability data sharing</i>	.13	.766	0.17	.865	1.372	1.632	
<i>Publicly target setting</i>	1.715	2.255	0.76	.447	2.704	6.135	
<i>Constant</i>	1.171	.606	-1.93	.053	2.358	.016	
<i>Mean dependent var</i>	0.395	SD dependent var		0.492			
<i>Pseudo r-squared</i>	0.426	Number of obs		86			
<i>Chi-square</i>	49.140	Prob > chi2		0.000			
<i>Akaike crit. (AIC)</i>	82.286	Bayesian crit. (BIC)		101.920			
*** $p<.01$, ** $p<.05$, * $p<.1$							

Other variables, while conceptually important, are not statistically significant in this empirical model.

5.6.2 Corporate Social Responsibility Policy

A logistic regression analysis examining factors influencing the likelihood of implementing Corporate Social Responsibility (CSR) policies was conducted. Companies were asked whether they have a corporate social responsibility policy (1=yes, 0=otherwise). In this regard, the model is found to be statistically significant (see Table 31) with **a Chi-square of 66.198 and a p-value of 0.000, confirming the model's overall significance at the 1% level.**

As it is defined in data analysis structure in chapter three, the dependent variable is measured as a dummy variable taking a value of 1 if the firm has a formal CSR policy and 0 otherwise. This variable reflects the firm's commitment to socially responsible practices. The independent variables include a mix of dummy and continuous variables capturing employee welfare and sourcing practices. Trade union represents whether the firm has an active trade union, health insurance indicates the provision of health coverage for employees, and employee appraisal captures the existence of regular performance evaluations, all measured as dummy variables (1 = yes, 0 = no). Local sourcing is a continuous variable representing the proportion of inputs sourced locally relative to total company sourcing, while rules and regulations for disabled employees are captured as a dummy variable indicating whether the firm has policies supporting disabled staff. Together, these independent variables are expected to influence the presence and implementation of a CSR policy, reflecting how internal labor practices and sourcing strategies contribute to broader social responsibility initiatives.

Trade Union: this variable is found to be Significant at the 5% level of significance ($p=0.012$). It is a positive, statistically significant coefficient, indicating that trade union membership strongly increases the likelihood of implementing CSR policies, perhaps because they advocate for employee welfare and ethical practices within their communities.

Health Insurance: highly statistically significant at the 1% level ($p=0.006$), indicating that providing health insurance is positively associated with CSR policies, suggesting that companies prioritising employee well-being are more likely to adopt such policies.

Local Sourcing: Highly statistically significant at the 1% level ($p=0.004$), the negative coefficient suggests that reliance on local sourcing decreases the likelihood of implementing CSR policies. This could be due to challenges in balancing local sourcing with broader sustainability and profitability goals.

Disabled Employees: Highly statistically significant at the 1% level ($p=0.004$), companies that employ disabled individuals show a strong positive association with CSR policy adoption, highlighting inclusivity as a major component of CSR initiatives.

Table 27 Corporate Social Responsibility Policy: logistics regression

Corporate social responsibility policy	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Trade union	7.564	3.017	2.51	.012	1.651	13.477	**
Health insurance	2.9	1.061	2.73	.006	.819	4.98	***
Employee appraisal	1.408	.933	1.51	.131	-.421	3.236	
Local sourcing	-3.687	1.289	-2.86	.004	-6.213	-1.162	***
Disable employee	9.691	3.326	2.91	.004	3.172	16.209	***
Local employment	1.408	.933	1.51	.131	-.421	3.236	
Constant	-25.888	8.698	-2.98	.003	-42.935	-8.841	***
Mean dependent var	0.395	SD dependent var		0.492			
Pseudo r-squared	0.574	Number of obs		86			
Chi-square	66.198	Prob > chi2		0.000			
Akaike crit. (AIC)	75.228	Bayesian crit. (BIC)		107.135			
*** $p<.01$, ** $p<.05$, * $p<.1$							

Employee appraisal and local employment variables are found to be statistically insignificant in this particular empirical model.

In general, chapter five presents the analysis and discussion of data collected from Ethiopian manufacturing firms regarding sustainable supply chain management, with a focus on environmental practices, corporate social responsibility, occupational health and safety, and the key drivers, barriers, and determinants of sustainability performance. The findings indicate that environmental sustainability is gaining strong attention among manufacturers, as 77% of firms have established company-level environmental policies addressing areas such as energy efficiency, waste reduction, sustainable sourcing, and carbon management. This demonstrates a growing awareness and commitment to sustainability. However, responsibility for environmental management varies across firms, with some assigning it to dedicated departments while others rely on top management or production units. Most firms conduct periodic monitoring and evaluation of environmental performance, which supports compliance and early problem detection. Nevertheless, a notable portion of firms do not monitor performance regularly, exposing them to regulatory, operational, and reputational risks. Although many firms have set energy-efficiency targets, a majority do not disclose greenhouse gas emissions or sustainability targets publicly, mainly due to lack of expertise, weak regulatory pressure, and fear of reputational damage.

The study further reveals that CSR practices are widely adopted, with over 90% of firms having formal CSR policies that address both employee welfare and community engagement. Drawing on the Resource-Based View (RBV), the findings suggest that CSR enhances firm performance by improving reputation, strengthening stakeholder relationships, and increasing employee satisfaction. Similarly, occupational health and safety practices are recognized as important, although only 44% of firms are certified under ISO 45001. Firms that adopt OH&S standards benefit from improved workplace safety, reduced accidents, enhanced productivity, and better compliance with legal requirements, which ultimately contribute to improved organizational performance.

Through factor analysis, the study identifies key drivers and barriers influencing the adoption of sustainable supply chain practices. The main external drivers include government regulations and customer pressure, particularly from international markets that demand environmentally friendly and ethically produced goods. Internal drivers include top management commitment, operational efficiency goals, profitability considerations, employee influence, and firm size. Among these, top management commitment plays a critical role in integrating sustainability into organizational strategy and operations. On the other hand, the major barriers include lack of technical capability, insufficient knowledge and training, absence of a clear sustainability strategy, limited top management commitment, and high implementation costs. These barriers are interconnected, as lack of knowledge and training reduces employees' ability to implement sustainability practices, while absence of strategy leads to weak planning and monitoring systems.

The econometric analysis further confirms the positive impact of sustainability practices on firm performance. The linear regression results show that environmental policies, environmental management system certification, CSR policies, and health and safety certifications are all positively and significantly associated with profitability. This implies that firms adopting sustainability practices benefit from cost savings, improved efficiency, enhanced reputation, and increased market opportunities. Logistic regression results also indicate that firms with higher market share and those exporting to stricter international markets are more likely to obtain environmental certifications. Additionally, CSR adoption is positively influenced by factors such as trade union presence, provision of health insurance, and inclusive employment practices, while local sourcing shows a negative association.

Overall, the chapter concludes that while Ethiopian manufacturing firms are making meaningful progress in adopting sustainable supply chain practices, significant gaps remain in areas such as monitoring, reporting, technical capacity, and strategic implementation. Importantly, the findings highlight that sustainability is not only a regulatory or ethical requirement but also a key driver of financial performance and competitive advantage. Strengthening regulatory enforcement, enhancing training and awareness, and promoting transparency are therefore essential to accelerate the adoption and effectiveness of sustainable supply chain practices in the sector.

CHAPTER SIX

FRAMEWORK DEVELOPMENT AND VALIDATION

6.1 Introduction to the Validated Framework

There are various methods for developing and validating a framework. These are descriptive, empirical, and conceptual. The descriptive framework is based on explanatory research, whereas the empirical framework is based on phenomena observed and measured. A conceptual framework refers to the organisation of ideas or concepts (Bouzon *et al.*, 2012). Hence, this study has applied descriptive, empirical, and conceptual methods to develop and validate the framework. Review and survey design were also used as research designs in developing the framework. Data collection used both questionnaires and structured interviews in this study, and the results were analysed to validate the framework.

6.2 Framework Validation Based on DMAIC

Ethiopia's manufacturing industry has expanded significantly, with the establishment of industrial parks contributing to its growth. Nonetheless, this development has introduced fresh challenges, especially in reconciling industrial growth with sustainability. Numerous large and medium manufacturing sectors, including textiles, garments, cement, food processing, metals, and chemicals, face on going challenges such as poor resource efficiency, waste generation, low supplier compliance, and inadequate oversight of environmental and social performance. This section illustrates DMAIC as a functional validation framework to improve sustainability performance and operational efficiency.

A. Define Stage

At the national level, the Define phase began with broad recognition of sustainability as a crucial factor in competitiveness across various manufacturing industries. Manufacturing industries have recognised significant issues, including excessive energy and water use, ineffective logistics systems, inadequate waste management, and inconsistent adherence by suppliers to environmental and labour regulations.

According to the Nationally Determined Contributions Registry, the Ethiopian government established collective sustainability goals to reduce greenhouse gas (GHG) emissions by 68.8% by 2030.

B. Measure Phase

The Measure phase consisted of gathering and evaluating baseline data from a representative sample of medium- and large-sized manufacturing companies across major sub-sectors. The aim is to measure present performance standards and recognise significant sustainability deficiencies

Key findings:

- More than 64% of manufacturers do not have the practice of reporting their GHG inventory either to CDP or to the public due to a lack of knowledge or framework to effectively handle and disclose GHG emissions, and less regulatory demands and pressures to report
- 77% of the manufacturers have a company-level environmental policy/manual, however, characterised by weak implementation.
- The results indicate that financial contributions to local community development initiatives score the highest mean of 4.03 compared to other community engagement activities by manufacturing firms.
- 44% of manufacturers are certified to OH&S whereas 56% of the manufacturers are not certified to OH&S.
- A significant number of manufacturers responded that they do not have formal trade unions in their companies. This is a serious problem that signals basic rights to freedom, and the collective bargaining power of their employees might be neglected.
- The company works only with certified suppliers, which is the most important variable, with a 3.849 mean score in the supplier integration category, followed by the company demanding that suppliers sign a code of conduct as a prerequisite to working together, with a 3.698 mean score.

- The average annual energy consumption (in Mwh) is 51833.2 60.0, 269.3, and 52.2 for textile, clothing, and footwear, paper industry, building and construction, and food and beverage type of manufacturing, respectively.
- The average annual water consumption (in Litres) is 61625000, 150000, 2633416667, 24823000, and 250000 for Textile, Clothing and Footwear, Paper Industry, Building and Construction, Food and Beverage, and Automotive, respectively.
- The annual generated wastewater (in litres) is 1838500, 75000, 552000, 30027200, and 3000000 for Textile, Clothing and Footwear, Paper Industry, Building and Construction, Food and Beverage, and Automotive, respectively

C. Analyse Phase

The Analyse phase concentrated on determining the underlying barriers to sustainable supply chain implementation. Utilising the factor analysis model, the main barriers are identified.

Barrier of sustainable supply chain implementation:

- According to Factor analysis results, the absence of ability to engage in sustainable practice and the absence of organisational strategy for sustainability are identified as the main barriers, followed by the absence of knowledge and training.
- Inadequate commitment by top management, the cost of sustainable supply chain implementation and the cost of environmentally friendly raw materials are subsequently identified as the main barriers.

By classifying these reasons, industries could prioritise areas for enhancement according to possible effect and practicality

D. Improve Phase

During this phase, the manufacturing industries coordinated initiatives to address the identified barriers.

Improvement actions:

- Disclose sustainability goals and performance
- Disclose annual sustainability goals and performance

- Setting Energy-use Efficiency Targets
- Establish sustainability performance indicators (KPIs) for key supply chain operations, energy consumption, water management, waste management, and carbon emissions.
- Excel in social sustainability performance
- Permit and encourage the formation of such employee associations (trade unions) for their mutual advantage.
- Follow the reporting standards by CDP as adhering to a recognised standard.
- Government- carry out frequent environmental assessments and encourage environmental protection certifications.

E. Control Phase

This phase focused on institutionalising sustainability practices and establishing the responsible unit and its skeleton.

The control mechanisms included:

- KPI unification and dashboard engine room to track sustainability practice.
- Periodic sustainability audit and certifications
- Talent development in sustainability metrics and exchange of best practices.

Implementing the DMAIC framework at the industry level enhances environmental performance while simultaneously bolstering competitiveness and supply chain resilience. The initiative has enhanced brand reputation and bolstered investor confidence in Ethiopia's industrial sector.

Table 28 Summary of Framework Validation Based on DMAIC

Phase	Objective	Activities	Expected Result
Define	• Identify sustainability objectives	• improvement across Ethiopia's manufacturing landscape	• Clear problem statement, sustainability goals
Measure	• Current performance	• Survey	• Survey results
Analyse	• Identify barriers	• Factory analysis	• List priority improvement areas
Improve	• Solutions for sustainable performance	• Disclose sustainability goals and performance • Disclose annual sustainability goals and performance.	• Improve sustainability practice • Improving resource efficiency,

		Setting Energy-use Efficiency Targets	strengthening supplier engagement
Control	Sustain and monitor improvements	Develop dashboards, audits, and training.	Continuous follow-up

In summary, the structured framework has shown to be especially effective in Ethiopia's evolving industrial landscape, where limitations in capacity, resources, and data frequently hinder sustainability efforts. As more manufacturers embrace this strategy, Ethiopia's manufacturing industry is poised to advance toward a sustainable, competitive, and inclusive industrial future.

6.3 Description of the Validated Framework

This research developed a sustainable supply chain framework that can enhance the overall sustainability performance of Ethiopian medium- and large-scale manufacturing firms when they properly implement a comprehensive sustainable supply chain practices framework (see Figure 21), which combines the key performance indicators for each sustainable supply chain dimension.

In the developed sustainable supply chain framework, environmental sustainable supply chain practices are defined as the set of sustainability practices that enhance the ecological performance such as increased energy use efficiency, reduced carbon emissions, and pollution, waste management, water management, recycling and reuse of materials and mitigate risks related to environmental regulations during the entire supply chain system operations that is from designing of sustainable sourcing, procurement, manufacturing, distribution of a product, and return and recycle. On the other hand, socially sustainable supply chain practices are defined in the developed framework as practices that improve social performance, such as employee health and safety, human resource practices, reputation and community engagement, and local community living conditions. Lastly the developed sustainable supply chain practices

framework indicates economic sustainable supply chain techniques encompass a series of activities that improve the financial performance of manufacturing enterprises. These approaches enhance market share, facilitate expansion into new export markets, and augment the variety of export items. They also diminish resource waste, penalties associated with pollution, and carbon tax obligations, thereby reducing operational expenses. Moreover, companies can attain increased earnings by marketing eco-friendly items to ecologically aware consumers, simultaneously enhancing their reputation.

The Ethiopian medium and large manufacturing firms can achieve overall sustainability by critically assessing and identifying the drivers that inspires them to implement sustainable supply chain practices, and by critically identifying and rectifying the significant barriers that could impede the successful implementation of sustainable supply chain practices, and by adopting all identified sustainability key performance indicators (see figure 19), which encompasses various KPIs of all sustainable supply chain dimensions that are environmental, social, and economic.

Moreover, the Ethiopian manufacturing medium and large manufacturing firms can implement sustainable supply chain practices and can measure sustainable supply chain performance through numerous KPIs of sustainable supply chain in each supply chain operations or activities (that focuses in designing sustainable procurement, energy usage, water usage, waste management, production, and finally recycling and reuse of returned products) developed in this study's framework. This study developed a framework encompassing comprehensive sustainable supply chain key performance indicators and strategies to be applied by all Ethiopian medium- and large-sized firms in the manufacturing industry. Hence, this study contributes to the literature by developing a context-specific sustainable supply chain framework tailored to manufacturing firms in Ethiopia. The framework integrates economic, environmental, and social dimensions into a unified structure, providing a practical and measurable approach to assessing sustainable supply chain performance in emerging market contexts.

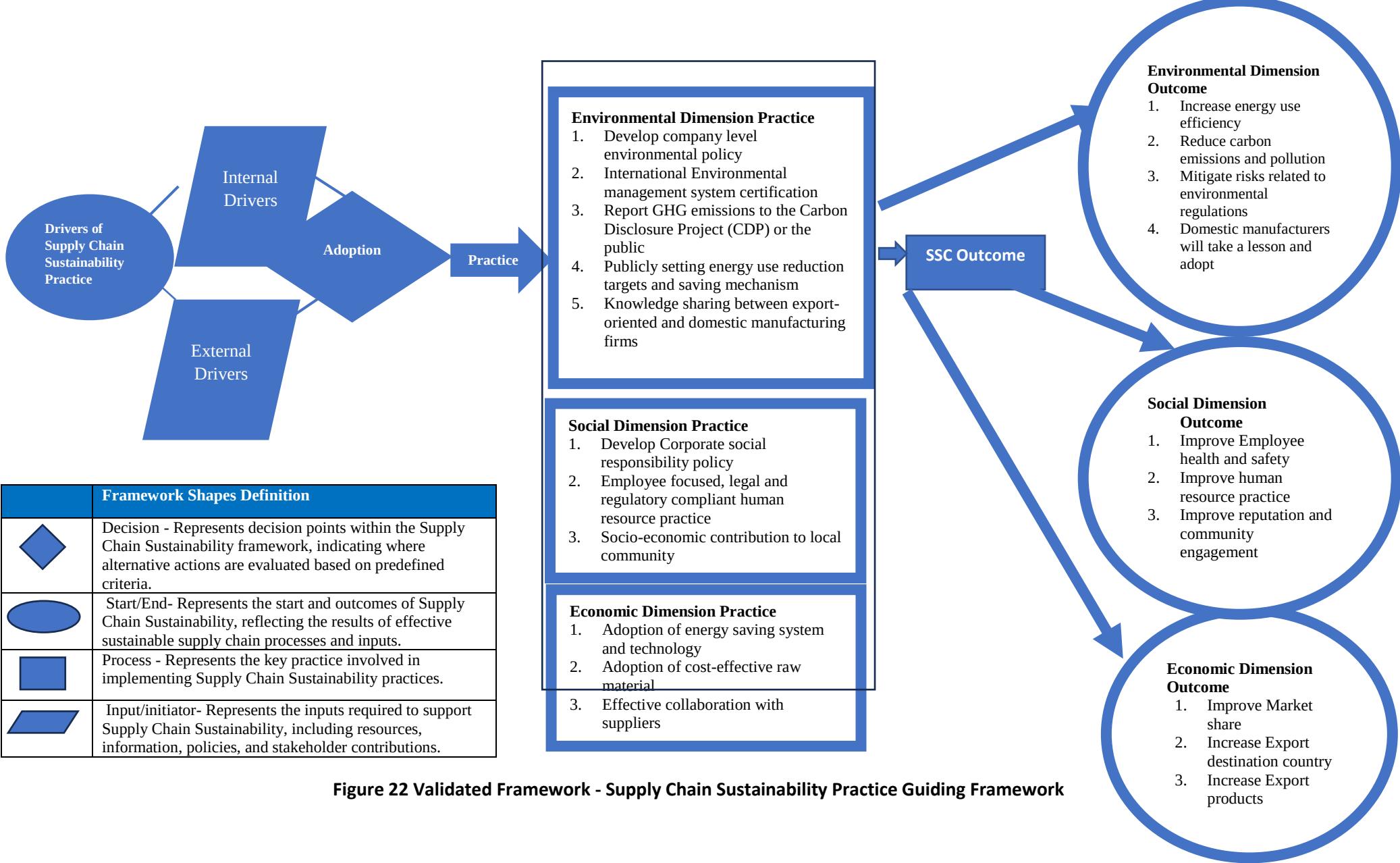


Figure 22 Validated Framework - Supply Chain Sustainability Practice Guiding Framework

CHAPTER SEVEN

CONCLUSIONS AND RECOMMENDATION

7.1 Conclusion

In this chapter, the research conclusions are presented by summarising the significant empirical findings and the analysis. In this conclusion section, the primary research questions are addressed. The aim of this research was to assess the practice, pressure, and performance of the sustainable supply chain in the Ethiopian manufacturing industry.

As a novelty of the study, a standardised framework has been developed for implementing, measuring, and evaluating sustainable supply chain management in Ethiopian manufacturing industries considering key concepts and variables. The study has also investigated and measured the current sustainable supply chain performance of the Ethiopian large and medium scale manufacturing industry, enabling the identification of drivers and barriers to effective SSCM implementation in Ethiopia. It also examines and evaluates the legal context surrounding the enforcement and oversight of sustainability practices in supply chains at both national and international levels, enabling Ethiopian manufacturing industries to understand and take the necessary steps to adopt sustainability practices to comply with legal obligations and succeed in their respective markets.

In the first Objective, the study investigated sustainable supply chain management practices in manufacturing industries through a comprehensive literature review and an empirical survey of Ethiopian manufacturing firms. The findings established the current level of adoption of social, environmental, and economic sustainability practices and identified key performance indicators relevant to the Ethiopian manufacturing context. Thus, this study concluded that the SSCM adoption in Ethiopian Manufacturing Industries is growing but fragmented. While the adoption of sustainable supply chain practices is steadily increasing across the Ethiopian manufacturing landscape, it remains highly uneven and fragmented. A significant structural divide exists between export-oriented firms and domestic-market firms:

- A. **Export-oriented manufacturers** demonstrate higher levels of SSCM integration, driven primarily by external institutional pressures, including international customer expectations, strict regulatory requirements, and global market compliance standards.
- B. **Domestic-market manufacturers** lag significantly in sustainability adoption and performance. This shortfall is largely attributable to weak local regulatory enforcement, limited government monitoring, and minimal pressure from domestic stakeholders.

In the second Objective, the study identified the key enablers and barriers influencing SSCM implementation in Ethiopian manufacturing industries. Quantitative analyses, supported by qualitative evidence, revealed the organisational, institutional, and resource-related factors that facilitate or hinder SSCM adoption. Thus, this study concluded that top management commitment, employee involvement, government regulation, and customer demand as the primary drivers propelling sustainable supply chain practices forward. Conversely, the transition toward fully sustainable supply chains is severely impeded by two main barriers:

- A. High implementation costs associated with adopting green technologies and sustainable practices.
- B. A severe deficit in specialized knowledge and practical training among workforce personnel and management teams.

Regarding the third objective, the study examined the relationship between SSCM practices and firm performance. Factor analysis established valid measurement constructs, while OLS regression demonstrated the influence of SSCM practices on firms' gross profit. Logistic regression further identified the determinants of Environmental Management System certification and Corporate Social Responsibility adoption, providing empirical evidence on the factors associated with sustainability implementation. Contesting the conventional assumption that sustainability is purely an operational cost burden in resource-constrained environments, the Ordinary Least Squares regression analysis confirms a statistically significant, positive association between structured sustainability practices and firm gross profit. Specifically, companies that formalize environmental policies, attain Environmental Management System certifications (such as ISO 14001), and implement Corporate Social Responsibility policies

achieve higher financial returns. Strategic sustainability is thus empirically validated as a value-generating driver rather than a trade-off against financial viability.

With respect to the fourth objective, based on the empirical findings, the literature review, and qualitative insights, the study developed a sustainable supply chain performance measurement framework. The DMAIC methodology provided a structured process for translating the research findings into a practical framework suitable for Ethiopian manufacturing industries. Addressing the fifth objective, the proposed framework was verified and validated through expert evaluation, confirming its relevance, practicality, and applicability for assessing and improving SSCM implementation within the Ethiopian manufacturing sector.

Methodologically the study uses different approach to achieve the conclusion; research objective one was attained through an intensive literature research and descriptive statistical analysis of survey data to evaluate the extent of sustainable supply chain management (SSCM) practices in the manufacturing sector. The five-point Likert scale was analysed using established interval ranges, allowing the study to assess the degree of agreement and overall adoption level of SSCM practices. Research objective two was achieved through the application of Exploratory Factor Analysis (EFA), which reduced a large set of correlated variables into a smaller number of meaningful factors. This approach enabled the identification of key enablers and barriers influencing SSCM implementation, while eliminating redundancy among variables and uncovering the underlying structure of the data. Research objective three was achieved by employing both Ordinary Least Squares (OLS) and logit regression models to examine the relationship between SSCM practices and firm performance. The OLS model was used to assess the impact of SSCM-related variables on financial performance (gross profit), while the logit model analysed the likelihood of adopting sustainability-related practices and certifications based on firm-level characteristics and performance indicators.

7.1.3 Determinants of Sustainable Supply Chain Performance

- The finding shows that there is a positive correlation between profit and certifications for environmental management systems. Companies that hold environmental certifications tend to be more profitable than manufacturers that do not.

- Similarly, companies that have expanded or improved their export destinations are more likely to possess international environmental certifications. The positive and statistically significant coefficient suggests that exporting to certain countries or economies, particularly those with stricter environmental standards, may increase the likelihood of certification.
- The presence of a corporate social responsibility policy is positively correlated with profit, suggesting that companies with such policies are more likely to achieve financial success.

Those who possess Health and Safety standard certifications are more likely to be profitable when compared to their counterparts without these certifications. Market share shows a positive and significant correlation with international environmental certifications. Companies that have improved their export destinations are more likely to obtain international environmental certifications. Trade unions are positively associated with the establishment of corporate social responsibility policies, suggesting that manufacturing industries with strong trade unions are more likely to have such policies in place. A working environment that accommodates employees with disabilities is associated with the presence of a corporate social responsibility policy. Health insurance is significantly and positively associated with social responsibility. Overall, the study successfully achieves its three main objectives by demonstrating that while sustainable supply chain practices are increasingly adopted in the Ethiopian manufacturing sector, their implementation remains inconsistent. The findings reveal that internal organisational capacity, financial constraints, and regulatory enforcement gaps are key challenges. At the same time, the study confirms that effective SSCM practices contribute positively to firm performance, particularly in terms of profitability, competitiveness, and social responsibility. These insights provide a strong foundation for policymakers and industry leaders to strengthen sustainability integration across the supply chain.

7.2 Recommendation

The manufacturing sector frequently comes up in discussions among policymakers and researchers regarding environmental and social issues, given its substantial adverse environmental impacts and its role in the socio-economic sphere. The manufacturing industry needs to embrace and create sustainable solutions to the environmental challenges resulting from its operations. However, due to the scale and complexity of their processes, manufacturing companies face numerous obstacles when implementing sustainable supply chain practices. Hence, this research provides significant implications/recommendations for manufacturing industry managers and makers. Policymakers and regulatory bodies in developing nations such as Ethiopia can benefit from this research by evaluating sustainable supply chain practices in the manufacturing sector to gain deeper insight into existing obstacles. Additionally, these policymakers can emphasise the development of capabilities within the manufacturing sector by supporting technology adoption and providing skills development training for manufacturing employees.

The findings of this study also have significant implications for manufacturers' managers who are implementing sustainable supply chain practices. This research will help managers pinpoint the most critical obstacles to sustainable supply chain practices. Given that the adoption of sustainable supply chain practices is essential to the survival of manufacturing companies, managers must thoroughly assess the barriers to implementing them. By evaluating the relative significance of the various categories and obstacles, they should devise appropriate strategies to address these issues. Practitioners ought to take swift action to eliminate the barriers that hold the highest prominence.

7.2.1 Specific Recommendations

This research delivers a strategic framework for the Ethiopian manufacturing industry to address sustainable supply chain implementation obstacles. This research highlights the key internal and external obstacles to sustainable supply chain implementation in Ethiopia's manufacturing sector, a developing country. Manufacturing companies can address these identified obstacles to

successfully implement sustainable supply chain practices. This research identified ‘absence of organisational strategy for sustainability, absence of ability to engage in sustainable practice, inadequate commitment by top management, absence of knowledge and training, cost of sustainable supply chain implementation, cost of environmentally friendly raw materials, absence of customer serious demand for sustainable products/solutions, absence of customer awareness about sustainability, unwillingness from suppliers to collaborate and/or share information as significant challenges that impede sustainable supply chain implementation.

For the barriers related to employees’ lack of knowledge, ability, and training, managers of these manufacturers should create:

- Special training workshops and initiatives on related sustainability issues, such as sustainable procurement, sustainable logistics, and circular supply chains, to improve the technical abilities and skills of their workforce.
- Establish a multidisciplinary sustainability team in the organisation comprised of members from procurement, operations/production, logistics, and research and development to work on sustainable supply chain adoption prominently.
- Partner with Ethiopian educational institutions/Universities, academicians or researchers on the area of sustainability, non-governmental organisations, local media, and various direct addressee groups (can be internal or international groups) to keep updated on optimal practices, changes in sustainability-related regulations, and new trends in sustainability.

Among the identified barriers this study found, the lack of serious customer demand for sustainable products/solutions, and the absence of customer awareness of sustainability are critical. Consequently, Effective strategies are necessary to enhance customer awareness. Addressing these challenges requires a coordinated effort to inform, engage, and influence customer behaviour. The following strategies are recommended to enhance customer awareness and stimulate demand for sustainable products

- When engaging in contracts with local buyers, manufacturing companies should discuss, promote, and convince them to purchase eco-friendly products.
- Manufacturers can educate customers about the long-term advantages of buying and consuming green products and the connection between sustainable supply chain practices and the overall well-being of society.
- All parties concerned, including manufacturers, industry policymakers, and government entities, should launch suitable campaigns to increase awareness among local customers.
- By educating consumers about the environmental effects of manufacturing industry practices, they will gain insight into the sustainable supply chain process, leading to higher demand for sustainable products. For instance, government agencies can raise consumer awareness of eco-friendly products and their environmental benefits through TV commercials, social media, and environmentally conscious training programs.
- Ethiopians place a great deal of importance on social and religious gatherings, and they also have a propensity to believe what is said on these occasions. As a result, manufacturers, in collaboration with the government, should designate experts to conduct sustainability awareness training sessions at these events.

The high cost of sustainable supply chain implementation and the high cost of environmentally friendly raw materials have been identified as other critical obstacles, mainly due to insufficient financial resources and a weak procurement strategy in the manufacturing industry. These barriers also contribute to the weak commitment and motivation that top management in manufacturing firms exhibits toward adopting sustainability practices. To address this,

- The governments of Ethiopia ought to provide suitable incentives to encourage manufacturers to adopt sustainable supply chain practices. Hence, the government of Ethiopia can adopt strategic incentive policies, including financial rewards, by drawing on lessons from developed countries that already have these incentives in place.
- The government should introduce green taxation and subsidies, and it should provide various privileges that are tailored to the manufacturers, to encourage domestic

manufacturers to embrace sustainable supply chain practices. Consequently, managers of manufacturing firms will be willing and committed to implementing a clear, well-defined sustainability strategy in their organisations. This is because top management oversees establishing the organisation's vision and policies and informing its employees accordingly.

- Additionally, managers should be committed to building the appropriate infrastructure needed to implement sustainable supply chain practices, should provide training for sustainable practices, should provide resources to implement sustainability initiatives, and encourage employees to adopt sustainable supply chain practices within their organisations, should concentrate on enhancing overall cost reduction via using energy efficient technologies and waste reduction, using renewable energy sources, or energy-efficient. Ultimately, the success of adopting sustainable supply chain practices relies on top management.

A lack of a tightly regulated policy and support was found to be another critical barrier in this study. Hence, to guarantee that all manufacturers adopt sustainable supply chain Practices,

- The government should implement stringent sustainability policies and standards to regulate the proper implementation of sustainable supply chains within the manufacturing industries. Policymakers or the Ethiopian government should not expect manufacturers to embrace environmentally friendly practices without first establishing a robust regulatory framework.
- The government should advocate strong sustainability policies and assist manufacturers that focus on prioritising better socio-environmental sustainability projects and initiatives.
- The government should ensure that environmentally friendly raw materials are accessible in the local market at an affordable price, as the cost of environmentally friendly raw materials is found to be a critical obstacle in this study.
- The government of Ethiopia should offer tax incentives, eliminate registration and other related fees, provide working places/spaces for free or at reduced cost, and provide other

privileges to the local businesses that participate in supplying environmentally friendly raw materials to the manufacturers.

Unwillingness among suppliers to collaborate and/or share information, related to a lack of suppliers' capabilities, was found to be a major hindrance to the successful implementation of a sustainable supply chain. To overcome this challenge, manufacturers must strengthen their collaboration with supply chain partners, including suppliers.

- Effective, sustainable supply chain adoption can only be achieved when there is strong coordination among all participants within a supply chain.
- There should be strong manufacturer-supplier integration. Manufacturers should provide suppliers with information and training to help them understand and implement sustainable practices, such as waste minimisation, green technology, and sustainable procurement.
- Manufacturers and suppliers should concentrate on leveraging social capital through information, technology, and resource sharing, which is quite beneficial for both and can bring a win-win scenario.

This study provides critical policy implications for manufacturers and the government regarding social and environmental sustainability.

7.2.2 To Manufacturing Industries

A range of social sustainability initiatives should be implemented to ensure that the needs of all stakeholders are addressed. In this regard, manufacturers should:

- Disclose sustainability goals and performance with their employees, investors and public.
- Empower employees to express their opinion.
- Provide fair and equitable compensation to employees for their contribution to the company.

- Manufacturers should practically prove that they are keen to excel in social sustainability performance.
- It is advised that manufacturing companies acknowledge the presence of trade unions as a means to promote social sustainability. Additionally, this recognition is a fundamental labour right that enables employees to exercise their right to collective bargaining.
- Therefore, management should permit and encourage the formation of such employee associations for their mutual advantage.
- Manufacturers should engage in community charitable initiatives, such as motivating their employees to take part in local volunteer efforts, establishing social service agencies to support the elderly, and helping to ease the employment burden on the government and play a key role in the welfare of society.
- Setting Energy-use Efficiency Targets: Regarding energy-use efficiency targets, it is found that the manufacturers are good at setting energy-use efficiency targets, but they prefer not to make these targets public. However, manufacturers should understand that publicly setting energy reduction targets will enhance top management and employees' commitment to achieving them and boost the firm's credibility and public acceptance. Therefore, Ethiopian manufacturers should establish and implement sector-specific sustainability performance indicators (KPIs) for key supply chain operations like energy consumption, water management, waste management, and carbon emissions. Moreover, developing and consistently implementing the CDP's established reporting standards, as well as adhering to recognised standard reporting, helps manufacturers enhance credibility and comparability among stakeholders.

7.2.3 To Government

In pursuit of achieving a sustainable supply chain goal, the government of Ethiopia should:

- Carry out frequent environmental assessments of local manufacturing firms and encourage them to secure environmental protection certifications and implement a product life cycle analysis system.

- Aim to foster positive and open government-manufacturer relationships while promoting sustainable supply chain developments. For instance, the government should support and collaborate with manufacturers to create eco-friendly, recyclable products.
- Take the initiative to guide and support manufacturing firms to have a strong partnership with institutions formed by stakeholders like the Ethio Logistics Sectorial Association (ELSA) to build a sustainable reverse logistics system that minimises carbon emissions and energy use. ELSA is established to comprehend, assist, and champion the needs of logistics service providers, users, government, and other stakeholders through suitable legislation, policies, processes, procedures, and operational performance, thereby aiming to establish dependable, effective, efficient, and highly integrated logistics operations in Ethiopia.
- Safeguard the rights and interests of employees, and make sure that all manufacturers are placing a strong emphasis on the health and well-being of employees first to enhance organisational endurance through the internationally acknowledged occupational health and safety management system.
- Encourage the sharing of Corporate Social Responsibility practice-related information among manufacturers and rigorously evaluate their performance.
- Reward and publicly recognise those manufacturers who excel in CSR practices.
- Strictly inspect and control the manufacturers' environmental sustainability practices and performance at the right intervals. This study found that a significant number of manufacturers don't disclose their GHG emissions to CDP or the public due to lax governmental oversight and control.

By adopting these strategies, both manufacturers and the government can successfully rectify the barriers to adopting sustainable supply chain practices. These strategies will not only help reduce the environmental impact of manufacturing activities but could also drive long-term cost savings, improve the company's reputation, increase operational efficiency, and enhance the well-being of current and future generations.

8 Limitations and Future Research Suggestion

8.1 Limitations

This study has several limitations that should be acknowledged. First, the analysis is confined to medium- and large-scale manufacturing firms in Ethiopia, which may limit the generalizability of the findings to small enterprises or other sectors. In addition, the study focuses primarily on firm-level perspectives, without incorporating data from other actors such as customers, which may restrict a comprehensive assessment of sustainable supply chain practices across the entire supply chain. Second, the study relies on cross-sectional data, which limits the ability to capture changes in sustainable supply chain practices over time or establish causal relationships. Finally, data availability posed a constraint. Given that sustainable supply chain management is still an emerging area in Ethiopia, access to detailed and reliable data was limited, which may have affected the depth of the analysis.

8.2 Future Research

Sustainable supply chain management remains a dynamic and evolving field, offering extensive opportunities for further scholarly inquiry. As global expectations around sustainability continue to expand, future research could explore the adoption of sustainable supply chain practices in industries that operate under comparatively lower regulatory, customer, and media pressure than the manufacturing sector. Such studies would provide valuable insight into whether sustainability adoption is primarily driven by external pressure or internal strategic intent. In addition, comparative analyses across African countries would enrich the current understanding of how contextual factors such as institutional frameworks, economic development levels, and infrastructure shape the implementation of sustainable supply chain practices. These insights would not only deepen academic discourse but also support practitioners and policymakers in designing contextually relevant and effective sustainability strategies. By extending research into these areas, future studies can contribute to a more comprehensive and grounded understanding of sustainable supply chains, thereby reinforcing their role as a critical enabler of long-term economic, environmental, and social value creation.

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APPENDICES

Appendix 1- Questionnaire

Dear Respondent,

I am a PhD student at Liverpool John Moores University and I am conducting a study entitled “Supply Chain Sustainability and Firm Performance: Enquiry into Practice, Pressure, and Performance among Large and Medium Manufacturing Industries in Ethiopia” to fill the requirement for the completion of my PhD.

The aim of the study is to investigate the practices of integrating sustainability into the supply chain system, and assess the role of socially, environmentally, and economically sustainable supply chain practices in empowering the firm’s performance among large manufacturing industries in Ethiopia. Through your participation, I eventually hope to acquire the necessary information and data.

Enclosed with this letter is a questionnaire that asks a variety of questions about your attitudes toward sustainable supply chain management of your esteemed company. Your responses will not be identified with you and the companies that participate in the study will not be disclosed.

I hope you will take enough time to complete this questionnaire. I thank you in advance for sparing your time and your sincere cooperation.

Sincerely,

Mebrat Aregawi Weldemicahel
Liverpool John Moores University

Section 1. General Information

NO.				
1.	Company Name			
2.	Type of ownership of your company			
	☐ Corporation	☐ Share Company	☐ Partnership/joint venture	
	☐ Private limited company	☐ Sole proprietorship	☐ Cooperatives	
3.	Address			
4.	Years of operating experience			
	☐ 1-3			
	☐ 4-6			
	☐ 7-10			
	☐ More than 10 years			
5.	Number of Employees			
6.1	Male			
	Second Degree and Above			
	First Degree			
	Diploma and Below			
6.2	Female			
	Second Degree and Above			
	First Degree			
	Diploma and Below			
6.	Gross profit of the last three years (In Birr)			
	2022			
	2021			
	2020			

Section 2. Drivers and Barriers

2.1 Drivers - To what extent has each of the following groups influenced your company to involve and improve its sustainability supply chain management practice

NO	Drivers	Very High Influence	High Influence	Average Influence	Little Influence	No Influence
1.	Government regulatory factors					
2.	International regulatory factors					
3.	Professional associations					
4.	Certifications as regulatory factors					
5.	Financial incentive from government					
6.	Competitive advantage					
7.	Expectation form shareholders					
8.	Competitors sustainability practice					
9.	Suppliers					
10.	Customer					
11.	Company image/reputation					
12.	Globalization					
13.	Local inhabitants/society (Public)					
14.	Media					
15.	NGO working in sustainability					
16.	Consumer associations					
17.	Top management commitment					
18.	Operational performance					
19.	Reduce the environmental impact					
20.	Profitability and productively					
21.	Socio cultural responsibility					
22.	Business ethics					

23.	Health issues					
24.	Resource depletion					
25.	Employees					
26.	Better workplace environment					
27.	Company Size					
28.	Company Geographical location					

2.2 Barriers- To what extent do the following factors affect your company's involvement and improve its sustainability supply chain management practice

NO.		Very Great Extent	Great Extent	Some Extent	Little Extent	Very Little Extent
1.	Cost of sustainable supply chain implementation					
2.	Cost of environmentally friendly raw materials					
3.	Absence organizational strategy for sustainability					
4.	Absence of ability to engage in sustainable practice					
5.	Inadequate commitment by top management					
6.	Absence of employee motivation in adopting SSCM					
7.	Unnecessary Organizational bureaucracy					
8.	Absence of knowledge and training					
9.	Absence of customer serious demand for sustainable products/solutions					
10.	Reluctance of customers to share costs					
11.	Absence of customer awareness about sustainability					
12.	Absence of societal awareness about sustainability					
13.	Unwillingness from suppliers to collaborate and/or share information					
14.	Insufficient regulatory requirements					

15.	Absence of government policies and incentives					
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Section 3. Supplier Integration

NO.		Strongly Agree	Agree	Indifferent	Disagree	Strongly Disagree
1.	The company demands supplies to sign code of conduct as a prerequisite to working together					
2.	The company request supplier a self-assessment annually/semi annually					
3.	The company only works with certified suppliers					
4.	The company shares data and information on environmental goals with suppliers.					
5.	The company shares data and information on environmental practices with suppliers.					
6.	The company shares data and information on product environmental requirements with suppliers.					
7.	The company shares data and information on green production with suppliers.					
8.	The company support suppliers to improve their environmental awareness.					
9.	The company supports suppliers to design their own environmental programs.					
10.	The company provides financial support to suppliers to purchase equipment for pollution prevention					
11.	The company supports suppliers to improve their operational processes green performance					

12.	The company provides learning and experience sharing on environmental management among the suppliers.					
13.	The company works with suppliers to accomplish the closed loop return process.					
14.	The company works with suppliers to achieve planning, distribution and outbound logistics planning					
15.	The company conjointly decides environmental impact reduction means with suppliers					
16.	The company is keen to establish long term relationship with its suppliers					
17.	The company consults crucial suppliers in new product development processes					
18.	The company awards its suppliers for quality					

Section 4. Environmental Dimension

4.1 Environmental Policy and Management System

No.	Questions	YES	NO
1	Do you have a company-level environmental policy/manual in place? If yes proceed to Q 1.1, 1.2, 1.3		
1.1	Who Is responsible for implementations follow up of environmental issues?		
	☐ CEO ☐ Separate Own Department ☐ Production Department Other _____		
1.2	How periodically do you monitor and evaluate your company environmental performance?		
	☐ Every 3 month ☐ Every 9 month		

	☐ Annually ☐ Not At all Other _____		
1.3	How frequent do you update your environmental policy/manual		
	☐ Every 3 month ☐ Semi-Annual ☐ Annual ☐ When it is needed Other _____		
2	Is your company Environmental Management System certified and approved by an external authorized certification body (e.g. ISO14001 or other relevant body)? If yes proceed to Q 2.1		
2.1	Who certifies your company?		
	Local Certification Company (Put Name) _____		
	International Certification Company (Put name) _____		
3	The company assess risks associated with the environment? If yes proceed to Q 3.1		
3.1	How frequent do you assess risks associated with the environment		
	☐ 3 month ☐ 9 month ☐ Annually ☐ Not At all Other _____		
4	The environmental policies, practices, and goals are properly communicated to employee		
5	The environmental policies, practices, and goals are properly communicated to suppliers		
6	The company provides training to its employee on environmental related issues. If yes proceed to Q 6.1		
6.1	Mention three training areas		
	1.		
	2.		

	3.	
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4.2 Sustainability Supply Chain Management Process And The Environment

No.	Questions	HIGH	MEDIUM	LOW
1.	Level of consideration for reduced consumption of material energy while designing a product			
2.	Level of consideration for products that can be reused, recycled, and recovered of its components			
3.	Level of consideration for products to reduce use of harmful/toxic material			
4.	Level of consideration for optimization of design process to reduce air emission and noise			
5.	Level of consideration for optimization of design process to reduce solid and liquid waste			
6.	Work in collaboration with customers on green and cleaner production processes			
7.	Work in collaboration with customers for green packaging			
8.	Work in collaboration with customer to use less energy while transporting a product			
9.	Mechanism to enable sustainability information sharing with customers			
10.	Work in collaboration with suppliers to minimize energy in transporting of a product			
11.	Work in collaboration with suppliers to achieve environmental objectives			
12.	Level of consideration to purchase eco-friendly materials			
13.	Work in collaboration with suppliers which are environmentally certified			

4.3 Sustainability Supply Chain Management Performance And The Environment

No.	Questions	YES	NO
1.	Partnerships with suppliers that aim to environmental solutions and/or development of environmentally friendly products.		
2.	Exported products has increased during last 2 years		
3.	Export market share has increased during the last 2 years		
4.	Country of export has increased during last 2 years		
5.	Export profit has increased in the last 2 years		

6.	Reduction of consumption of hazardous/toxic material during the last 2 years		
7.	Reduction of air emissions during the last 2 years		
8.	Reduction of effluent wastes during the last 2 years.		
9.	Improved environmental image /position during the last 2 years		
10.	Reduction of energy consumption during the last 2 years		
11.	Reduction of solid wastes during the last 2 years		
12.	Partnerships with suppliers that aim to environmental solutions and/or development of environmentally friendly products.		
13.	Exported products has increased during last 2 years		
14.	Export market share has increased during the last 2 years		

4.4 Environmental Sustainability Indicators

A. Greenhouse Gas (GHG) Emissions and Energy Usage

Qualitative Indicators

NO.	Questions	YES	NO
1.	The company monitor and track energy consumption? If yes,		
2.	What are the company energy consumption tracking and monitoring mechanism		
	1.		
	2.		
	3.		
3.	The company conduct energy audits periodically? If yes please continue to Q		
4.	How periodic do you conduct energy audit?		
	☐ Every 3 month		

	☐ Every 9 month ☐ Annually ☐ Not At all Other _____		
5.	The company have a system and mechanism in place to reduce the environmental impact of energy use and greenhouse gases? If Yes, Continue to Q 5.1		
5.1	What are the mechanism to reduce environmental impact of energy use and greenhouse gases		
	1.		
	2.		
	3.		
6.	The company have objective and target to reduce GHG emissions? If Yes, Continue to Q 6.1		
6.1	What are the targets to reduce GHG emissions?		
	1.		
	2.		
	3.		
7.	The company have objective and target to increase energy efficiency?		
8.	What are the targets to increase energy efficiency?		
	1.		
	2.		
9.	The company report GHG emissions to the Carbon Disclosure Project (CDP) or to the public?		
10.	Do you publicly set energy use reduction targets? If Yes, Continue to Q 10.1		
10.1	What are those targets? (Enter total metric tons and target date)		
	1.		
	2.		
11.	What challenges do you face in measuring your Greenhouse Gas (GHG) Emissions and Energy Usage		
	1.		

	2.	
	3.	

Quantitative Indicators

No.	Greenhouse gases	Measure	Put the Amount Here
1.	Annual Energy consumption	kWh	
2.	Annual Steam consumption	kWh	
3.	Annual Natural gas consumption	kWh	
4.	Amount of generated carbon monoxide	Metric tons	
5.	Share of high energy efficiency devices	%	

B. Air Emissions

NO.	Questions	YES	NO
1.	The company tests air emissions regularly? If Yes, continue to Q 1.1		
1.1	How frequent do you test air emissions?		
	1.		
2.	The company have a system and mechanism in place to manage air emissions?		
3.	What are the mechanism to reduce environmental impact of air emissions?		
	1.		
	2.		
	3.		
4.	The company set objective and target to reducing air emissions? If yes, continue to Q 4.1		
4.1	What are the targets to reducing air emissions?		
	1.		
	2.		
5.	The company have modern pollution prevention equipment?		

C. Water Management

Qualitative Indicators

NO	Questions	YES	NO
1.	The company have a procedure to monitor water withdrawals and consumption?		
2.	The company have a system and mechanism to reduce water use or reuse/recycle water?		
3.	What are the mechanism to reduce water use or reuse/recycle water?		
	1.		
	2.		
	3.		
4.	The company have objective and target to reduce water consumption? If yes, continue to Q 4.1		
5.	What are the targets to reduce water consumption?		
	1.		
	2.		
6.	The company manages wastewater generation?		
7.	The company treat wastewater before off-site discharge?		
8.	The company main source of water are? (you can select more than one)		
	☐ A. Aquifers		
	☐ B. Municipal water from local water body		
	☐ C. Harvested rainwater		
	Other _____		
9.	The company makes water source quality assessment? If Yes, continue to Q 9.1		
9.1	How frequent do you test air emissions?		
10.	1.		

Quantitative Indicators

No.	Water Management	Measure	Put the Amount Here
1.	Annual Water consumption	Liter	
2.	Annual Generated waste water	Liter	
3.	Water recycled internally	Liter	
4.	Annual Share of industrial water in total consumption	%	
5.	Share of devices with efficient utilization of used water	%	

D. Waste Management

NO.	Questions	YES	NO
1.	The company have a program and/or procedures to reduce or eliminate pollution and waste in its operations?		
2.	The company have a recycling program to reduce or eliminate pollution and waste in its operations?		
3.	The company have maintain records of off-site transfer, treatment, and disposal of waste?		
4.	The company conducts regular audits of waste disposal? If Yes, continue to Q 5.1		
5.	How periodic do you conduct energy audit?		
	☐ Every 3 month ☐ Every 9 month ☐ Annually ☐ Not At all Other _____		
6.	Do you measure waste generated from your company facilities? If Yes, continue to Q 6.1		
6.1	If measured please report total amount of waste generated from your facilities		
	Landfill waste in Tons -		
	Water waste in Tons -		

	Paper consumption Cut in% -		
	Share of recycled toxic waste in% -		
7.	Do you publicly set solid waste reduction targets? If Yes, continue to Q 7.1		
7.1	If yes, what are those targets? (Enter total metric tons and target date)		
	1.		
8.	Do you publicly set water waste reduction targets? If Yes, continue to Q 8.1		
8.1	If yes, what are those targets? (Enter total metric tons and target date)		
	1.		

E. Pollution Prevention

NO	Questions	YES	NO
1.	We use low impact transportation modes		
2.	The company considers Design for Environment (DfE) in its development of products?		
3.	The company uses life cycle assessment (LCA) as part of determining chemical selection for product inputs?		
4.	The company have uses chemical hazard assessment and/or comparative chemical hazard assessment as part of determining chemical selection for product inputs?		
5.	The company assess whether substances stored, used, or handled on-site are prohibited by national or international laws or protocols?		
6.	The company have a system in place to address pollution prevention and management of hazardous and potentially hazardous substances?		
7.	The company maintains up-to-date material safety data sheets (MSDS) for all hazardous substances used on-site?		
8.	The company have set targets in relation to eliminating or reducing hazardous substances on-site? If Yes, continue to Q 8.1		
9.	If yes, what are those targets in relation to eliminating or reducing hazardous substances on-site?		
	1.		
10.	Does the facility conduct tests to identify impact on soil and groundwater from facility operations?		

11.	The company keep inventory of all chemical substances used, stored, processed, and manufactured?		
12.	The company monitors the noise levels and air quality		
13.	1. How frequently-		

Section D. Employee Dimension

A. Workplace Management

No.	Questions	YES	NO
1.	Is there a formal corporate responsibility policy or statement of commitment in your company outlining its approach to labour, health, and safety standards?		
2.	Is there a policy in place that prohibits forced labour and underage labour in the company		
3.	The company has an official personnel policy in place that covers benefits and deductions		
4.	The company has an official personnel policy in place that covers Discipline and termination		
5.	The company has an official personnel policy in place that covers Grievance procedures		
6.	The company has an official personnel policy in place that covers Harassment and abuse.		
7.	The company has an official personnel policy in place that covers Overtime hours		
8.	The company has an official personnel policy in place that covers Overtime wage rates		
9.	The company has an official personnel policy in place that covers Regular hours		
10.	The company has an official personnel policy in place that covers Vacation and leave		
11.	Does the official personnel policy applicable to all workers, including non-Ethiopian citizens		
12.	Is the company's performance management system in accordance with applicable social rules and regulations		
13.	Is there an employee appraisal system in place at the company that covers both regular staff and contractual workers/trainees		
14.	Is there a standardized set of formal and written policies and procedures in place for disciplining and firing personnel throughout the company		
15.	Is physical punishment of employees firmly prohibited as a disciplinary measure at the company		

16.	Are all employees and suppliers informed of labour, health, and safety policies, practices, and expectations in local or relevant languages?		
17.	What modes of communication are used? ☐ Bulletin board posting ☐ Formal training ☐ Employee handbook/literature ☐ Electronic mail ☐ Formal meeting ☐ Website		
18.			

B. Health and Safety of Facility

No.	Questions	YES	NO
1.	Which environmental, health, and safety laws and regulations does the company follow?		
	1.		
	2.		
2.	Is the company currently certified to Health & Safety standards (OHSAS 18001, ANSI Z10, CSA Z1000, BSI 8800, or OSHA VPP) If Yes, continue to Q 2.1		
2.1	List the certification name if certified		
	1.		
3.	Is there a mechanism in place to ensure that the required machinery is well maintained and equipped with the necessary safety devices?		
4.	The factory have written procedures in the language(s) that workers understand for the safe storage, use, and disposal of each hazardous item used in production ?		
5.	Is there a mechanism in place to guarantee that personnel receive proper Personal Protection Equipment (PPE)		
6.	Is there a written emergency response plan and fire evacuation protocol in place at the facility?		

7.	Is the emergency response strategy and fire evacuation method disseminated in local or relevant languages to all parties who may be affected by the event?		
8.	How frequently does the facility hold emergency drills?		
9.	☐ One a year ☐ Twice a year ☐ When needed ☐ Not at all		
10.	During working hours and at all times, are all emergency exits unobstructed and unlocked from the inside?		
11.	Is there a mechanism in place to ensure that personnel are not denied permission or delayed from leaving the facility under justifiable circumstances (e.g., an emergency or personal urgency)?		
12.	Are the dormitory living arrangements clean, safe, and properly cooled, heated, lit, and ventilated?		
13.	Are dormitories located in a separate building or buildings from the production areas?		
14.	Are the restrooms clean, ventilated, furnished with running water, accessible, and well-lit at night?		
15.	Do all staff members who live in dorms have access to flowing water, clean drinking water, sanitary cooking equipment, and decently private showers?		
16.	Do all dorms have routinely tested fire alarms and extinguishers?		
17.	Do all employees who live in facility dorms have a way to secure their personal documents?		

C. Forced Labour

No.	Questions	YES	NO
1.	Employees have the right to leave their jobs at any time, without cause, and with reasonable notice		
2.	Is there child labour (employees under the age of 18) at the facility?		
3.	Do any young people work at night, in hazardous tasks, or are they exposed to chemicals, machinery, tools, or extreme cold, heat, or noise?		
4.	Is there an adequate mechanism in place at the factory for validating workers' ages?		

D. Freedom of Association & Collective Bargaining

No.	Questions	YES	NO
1.	Are there any rules supportive regulations in the company's in favor of workers' right to join or create their own trade unions or workers' organizations' and to bargain collectively?		
2.	Is it legal for workers to join or organize trade unions or workers' organizations of their own choosing and bargain collectively?		
3.	Does the factory recognize trade unions or other independent workers' organizations that represent employees in the workplace?		
4.	Is it possible for employees in the facility to participate democratically in the selection of representatives for trade union/labour union?		

E. Harassment & Abuse

No.	Questions	YES	NO
1.	Is there a formal, written policy in place that clearly outlines the facility's commitment to preventing workplace harassment and abuse?		
2.	Is there a policy in place to prevent physical abuse, corporal punishment, and physical contact with the purpose to damage or intimidate, and disciplinary methods that cause bodily discomfort?		
3.	Is there a mechanism in place to ensure that sexual harassment does not occur in the workplace?		
4.	Is there a mechanism in place to ensure that there is no verbal abuse or harassment in the workplace?		
5.	Is there a policy in place to document and report occurrences, complaints, cases, and management responses and actions relating to harassment and abuse?		

F. Compensation

No.	Questions	YES	NO
1.	Is there a mechanism in place to ensure that all employees receive all of the benefits to which they are entitled		

	upon hire?		
2.	Is there a mechanism in place to ensure that all employees receive the holidays and leave to which they are legally entitled?		
3.	Is there a mechanism in place to ensure that no unauthorized or illegal deductions from employee earnings are made?		
4.	Is there a system in place to ensure that all hours worked are included in payroll paperwork?		
5.	Is a written explanation of compensation and any deductions made available to all employees in their native or relevant language?		
6.	Which laws regulating working hours apply to this facility?		

Interview Questions

1. Local community impacts and Engagement

- Is there a company policy, strategy, or procedure in place to understand and address local community issues, as well as connect with affected stakeholders?

2. Indigenous people

- Is there a company policy, program, or procedure in place to connect with indigenous peoples and address their concerns and expectations?

3. Involuntary resettlement

- Could you describe the policies, programs, and procedures relating to indigenous peoples' involuntary resettlement?

4. Social investment

- Are there any strategies, programs, or procedures linked to the social investment its effectiveness?

5. Local content practices

- Could you please describe the policies and practices governing local content?

6. Local hiring practices

- Could you describe the company's approach and programs for hiring inhabitants of host countries?

7. Local procurement and supplier development

- Could you discuss the company's programs and processes to improve the capacity of local suppliers and contractors to support operations and carry out project

Appendix 2: Surveyed manufacturing industries

Company Name	Sector (Category)	Type of ownership	Size	Address
A	Automotive and Spare Parts	Private limited company	Large	Addis Ababa
B	Automotive and Spare Parts	Private limited company	Large	Addis Ababa
C	Automotive and Spare Parts	Private limited company	Large	Addis Ababa
D	Building and construction materials	Private limited company	Medium	Adama
E	Building and construction materials	Private limited company	Medium	Adama
F	Building and construction materials	Share Company	Medium	Addis Ababa
G	Building and construction materials	Share Company	Medium	Addis Ababa
H	Building and construction materials	Private limited company	Medium	Addis Ababa
I	Building and construction materials	Private limited company	Medium	Addis Ababa
J	Building and construction materials	Private limited company	Medium	Addis Ababa
K	Building and construction materials	Private limited company	Medium	Adama
L	Building and construction materials	Private limited company	Medium	Addis Ababa
M	Building and construction materials	Private limited company	Medium	Addis Ababa
N	Building and construction materials	Private limited company	Medium	Addis Ababa
O	Building and construction materials(Cement factory)	Private limited company	Large	Messebo Cement Factory
P	Building and construction materials(Cement factory)	Private limited company	Large	Dangote cement Ethiopia
Q	Edible oil Manufacturing	Private limited company	Medium	Addis Ababa
R	Edible oil Manufacturing	Private limited company	Medium	Adama
S	Edible oil Manufacturing	Private limited company	Medium	Adama

Company Name	Sector (Category)	Type of ownership	Size	Address
T	Energy, Mineral and chemical	Private limited company	Medium	Adama
U	Energy, Mineral and chemical	Private limited company	Medium	Adama
V	Energy, Mineral and chemical	Private limited company	Medium	Adama
W	Energy, Mineral and chemical	Private limited company	Medium	Adama
X	Energy, Mineral and chemical	Private limited company	Medium	Adama
Y	Energy, Mineral and chemical	Private limited company	Medium	Adama
Z	Engineering and Industrial products	Private limited company	Medium	Adama
AA	Engineering and Industrial products	Private limited company	Medium	Adama
AB	Engineering and Industrial products	Private limited company	Medium	Addis Ababa
AC	Engineering and Industrial products	Private limited company	Medium	Addis Ababa
AD	Food and beverage	Private limited company	Medium	Oromia Sheger city, Gelan subcity
AE	Food and beverage	Private limited company	Medium	Adama, Ethiopia
AF	Food and beverage	Private limited company	Medium	Adama, Ethiopia
AG	Food and beverage	Private limited company	Medium	Addis Abeba, around Lebu
AH	Food and beverage	Private limited company	Medium	Oromia Sheger city, Gelan subcity
AI	Food and beverage	Private limited company	Medium	Sululta
AJ	Food and beverage	Private limited company	Medium	Adama
AK	Food and beverage	Private limited company	Medium	Sebata
AL	Food and beverage	Private limited company	Large	Adama
AM	Food and beverage	Private limited company	Large	Sheger city, sebata
AN	Food and beverage	Private limited company	Large	Sheger city, sebata
AO	Manufacturing(gas and plastic)	Private limited company	Large	Addis Ababa
AP	Food and beverage	Private limited company	Large	Adama
AQ	Food and beverage	Private limited company	Large	Addis Ababa

Company Name	Sector (Category)	Type of ownership	Size	Address
AR	Food and beverage	Sole proprietorship	Large	Addis Ababa
AS	Food and beverage	Private limited company	Large	Adama
AT	Food and beverage	Private limited company	Large	Oromia Sheger city, Gelan subcity
AU	Manufacturing(gas and plastic)	Private limited company	Large	Around Addis Ababa
AV	Manufacturing(gas and plastic)	Private limited company	Large	Around Addis Ababa
AW	Manufacturing	Private limited company	Medium	Around Addis Ababa
AX	Manufacturing	Private limited company	Medium	Around Addis Ababa
AY	Manufacturing	Private limited company	Medium	Around Addis Ababa
AZ	Manufacturing	Private limited company	Medium	Addis Ababa
BA	Manufacturing	Private limited company	Medium	Around Addis Ababa
BB	Manufacturing(Pharmaceutical)	Private limited company	Large	Addis Ababa, Kilinto Industry Park
BC	Manufacturing(Pharmaceutical)	Private limited company	Large	Addis Ababa, Kilinto Industry Park
BD	Manufacturing (Coffee Processing)	Private limited company	Medium	Addis Ababa- Outskirt
BE	Manufacturing (Coffee Processing)	Private limited company	Medium	Addis Ababa- Outskirt
BF	Manufacturing (Coffee Processing)	Private limited company	Medium	Adama
BG	Manufacturing (Coffee Processing)	Private limited company	Medium	Addis Ababa- Outskirt
BH	Manufacturing (Mineral, energy and chemical)	Private limited company	Large	Addis Ababa
BI	Manufacturing (Mineral, energy and chemical)	Private limited company	Large	Addis Ababa
BJ	Manufacturing (Mineral, energy and chemical)	Private limited company	Large	Addis Ababa
BK	Manufacturing (Mineral, energy and chemical)	Private limited company	Large	Adama
BL	Manufacturing (Mineral, energy and chemical)	Private limited company	Large	Addis Ababa
BM	Manufacturing(Papermaking and printing)	Private limited company	Medium	Adama
BN	Manufacturing(Papermaking and printing)	Sole proprietorship	Medium	Oromia Sheger city
BO	Mechanical Engineering	Private limited company	Medium	Adama
BP	Manufacturing(Pharmaceutical)	Private limited company	Large	Addis Ababa, Kilinto Industry Park

Company Name	Sector (Category)	Type of ownership	Size	Address
BQ	Manufacturing(Pharmaceutical)	Share Company	Large	Addis Ababa, Kilinto Industry Park
BR	Sugar industry	Private limited company	Large	Wonji, Ethiopia
BS	Textile, clothing and footwear	Private limited company	Medium	Adama
BT	Textile, clothing and footwear	Private limited company	Medium	Adama
BU	Textile, clothing and footwear	Private limited company	Medium	Adama
BV	Textile, clothing and footwear	Private limited company	Large	Adama
BW	Textile, clothing and footwear	Private limited company	Large	Hawassa
BX	Textile, clothing and footwear	Private limited company	Large	Hawassa
BY	Textile, clothing and footwear	Private limited company	Large	Hawassa
BZ	Textile, clothing and footwear	Private limited company	Large	Hawassa
CA	Textile, clothing and footwear	Private limited company	Large	Hawassa
CB	Textile, clothing and footwear	Private limited company	Large	Hawassa
CC	Textile, clothing and footwear	Private limited company	Large	Hawassa
CD	Textile, clothing and footwear	Private limited company	Large	Hawassa
CE	Textile, clothing and footwear	Private limited company	Large	Addis Ababa, Bole Lemi Industry Park
CF	Textile, clothing and footwear	Private limited company	Large	Addis Ababa, Bole Lemi Industry Park
CG	Textile, clothing and footwear	Private limited company	Large	Addis Ababa, Bole Lemi Industry Park
CH	Textile, clothing and footwear	Private limited company	Large	Addis Ababa, Bole Lemi Industry Park