EVALUATION OF SUPPLY CHAIN MANAGEMENT PRACTICES IN INDIAN DAIRY INDUSTRY: A STUDY OF ORISSA STATE COOPERATIVE MILK PRODUCERS' FEDERATION

A thesis submitted to the University of Hyderabad in partial fulfillment for the award of the degree of

DOCTOR OF PHILOSOPHY

By

PRAMOD KUMAR MISHRA

SCHOOL OF MANAGEMENT STUDIES

UNIVERSITY OF HYDERABAD

JUNE, 2011

DECLARATION

I, **PRAMOD KUMAR MISHRA**, hereby declare that the thesis entitled, **"Evaluation of Supply Chain Management Practices in Indian Dairy Industry: A Study of Orissa State Cooperative Milk Producers' Federation"**, submitted by me under the guidance and research supervision of **Prof. B. RAJA SHEKHAR** is an original and independent research work. I also declare that, it has not been submitted previously in part or in full to this University or any other University or Institution for the award of any degree or diploma.

Place: Hyderabad — PRAMOD KUMAR MISHRA

Date: The 29th June 2011 — Regd. No: 07MBPH07

CERTIFICATE

This is to certify that this thesis entitled, **"Evaluation of Supply Chain Management Practices in Indian Dairy Industry: A Study of Orissa State Cooperative Milk Producers' Federation"**, submitted by **PRAMOD KUMAR MISHRA**, Research Scholar enrolled for Ph.D programme at the School of Management Studies, University of Hyderabad, is a bonafide work done under my guidance and supervision as prescribed under Ph.D ordinances of the University.

The thesis has not been submitted previously in part or in full to this or any other University or Institution for the award of any degree or diploma.

Research Supervisor	**Dean**
(Prof. B. RAJA SHEKHAR)	**(Prof. V. VENKATA RAMANA)**

ACKNOWLEDGEMENT

I am indebted to my Research Supervisor Prof. B. Raja Shekhar, School of Management Studies, University of Hyderabad, for his untiring guidance, support and encouragement over the last four years of research. I thank him for making me learn to work under pressure and to face difficult situations. I wish him a wonderful career ahead.

I express my sense of gratitude and thanks to Prof. V. Venkata Ramana, Dean, School of Management Studies, University of Hyderabad, for his support and encouragement during the last four years of research.

I express my sense of obligation and thanks to Doctoral Committee members – Dr. P. Jyothi, Dr. G.V.R.K. Acharyulu, and Dr. Chetan Srivastava, School of Management Studies, University of Hyderabad, for their continuous evaluation by providing invaluable inputs during different stages of the research work.

I express my sense of obligation and thanks to Prof. V. Sita, Dr. S. Mallikarjuna Rao and Dr. Mary Jessica, School of Management Studies, University of Hyderabad, for their valuable inputs and support during different stages of the research work.

I thank Dr. Sapna Singh, Dr. Srinivas Kumar and Dr. Ramulu and Mr. N. S. Rao, School of Management Studies, University of Hyderabad, for their encouragement and support during different stages of the research work.

I express my gratitude and thanks to Prof. B. Raja Shekhar, Prof. V. Venkata Ramana, Prof. V. Sita, Dr. Acharyulu and PURSE grants Officials for giving me a chance to attend an International Conference at Las Vegas, USA, with requisite funding. I thank Prof. B. Raja Shekhar (Dean Student Welfare and Coordinator for Distance Education, University of Hyderabad), Prof. I. Rambrahamam, Prof. Uma Maheswar Rao, Prof. Appa Rao and Prof. Anantha Krishnan (Erstwhile Chief Warden) for their invaluable support and help from time to time during my stay at University of Hyderabad.

I express my deep sense of gratitude to Prof. Narasimhulu, Dr. Sudhakar Babu and other Officials of UGC Academic Staff College, University of Hyderabad, for their help and support from time to time.

I would like to acknowledge the support and cooperation received from Mr. Vijaya Bhaskar, Mr. Krishna Murthy, Mr. Prakash, Mrs. Parimala, Mr. Narsing Rao, Mr. Santosh, Mr. Somanath, Mr. Malyesh, Mr. Sheetal Singh, Mr. Sharf-udd-in and others for their co-operation and support from time to time.

I would like to acknowledge the service received from my colleagues namely, M. Devi Prasad, M. Sudhakar, Sundar Sekhar Rao, N. Udaya Bhaskar, A. Subrahmanyam, S. Mahapatra and Prakash in proof reading various chapters and providing me their valuable inputs. I acknowledge the service received from my colleague Kiran Kumar, Indian Institute of Management Bangalore (IIMB) for proof reading a chapter and giving me valuable suggestions in accomplishing the dissertation editing.

I thank Swamy, Dr. Krishnaiah, Dr. Sanjay, Dr. Laxmi Priya, Uma Maheswari, Gayatri, Bhawani, Praveen, Balamani, Anjali, Sunitha, Manikya, Christy, Ajay, Ramaiah for their cooperation and support and wish them all a successful career ahead.

I thank Dr. Aupama, Dr. Sarvesh, Sirisa, Srinivas, Bhaskar Rao, Gangadhar, Ajay Shankar Gupta, Lalit Khurana, Azhar, China Babu, Nidhi, Christy, Anitha, Aparna, Sri Jyothi, Azhar (Jr), Srinu, Asha, Renuka, Mari Muttu, Moya, Prem Singh, Kranthi, Ramesh, Prarthana, Sekhar (Jr) and other co-scholars of School of Management Studies, University of Hyderabad, for their cooperation and wish them a successful career ahead.

I am thankful to finance section, student section, hostel and health centre officials of University of Hyderabad, for their cooperation and support in various capacities, without which the research would not have been completed. I would like to thank the Staff members of University of Hyderabad as a whole for their assistance during my research career in the past four years.

I acknowledge the great help received in due time from Mr. P. Upender, Asst. Registrar (Development Section) and In-Charge, Lake View Guest House, University of Hyderabad. I thank him for allowing me to stay in the Guest House for about a month to complete my dissertation editing and submission. I also thank Mr. Reddy and other staff of Lake View Guest House for their assistance during my stay at University of Hyderabad Campus.

I would like to thank Mr. Santosh Sarangi (IAS), Managing Director, Orissa State Cooperative Milk Producers' Federation (OMFED), Dr. Hrushikesh Panda (IAS), Principal Secretary to Govt. of Orissa for their assistance in data collection and valuable suggestions. I thank Mr. S. B. Samanta, General Manager (Finance), Mr. D. K. Dash, Dy. General Manager (MIS), OMFED, for providing me necessary data and information as and when I needed. Above all I thank Officials, Staff members and field executives of the Dairy Union/Federation for providing necessary data so as to help me in my research.

I greatly acknowledge the help and support received from Mr. K. S. Patro (Plant-in-Charge, Balasore Dairy), Ms. Rashmi Bindhani (Asst. Manager), Mr. Prasanna Kumar Mishra (Marketing and Transport Executive) and Mr. Sudhanshu Panigraphy (Accounts Executive), OMFED, during different phases of data collection for about a year. I also thank Mr. Pradeep Kumar Mishra for his assistance in data collection and field visits.

I acknowledge the support received from Library Officials and Staff members of Indian Institute of Management Ahmedabad (IIMA), IIMB, Veterinary Science College, Acharya N. G. Ranga Agricultural University (Hyderabad), Indian School of Business Hyderabad (ISBH), National Institute of Rural Development (NIRD, Hyderabad), Institute of Public Enterprise (IPE, Hyderabad) and Xavier Institute of Management Bhubaneswar (XIMB).

I am thankful to Prof. Devanath Tirupati, Prof. Jishnu Hazra, Prof. R. Ravikumar, Dr. Supriyo Roy (Post Doctoral Fellow), Mr. Raju H Subbarao of IIMB for their timely support in various capacities.

I am thankful to my wife Mrs. Monalisa Mishra for her contribution to dissertation editing and alignment during last phase of the research activities. I thank all my family members for their patience and untiring support so far and wish them all a successful life. I thank the family members of Prof. B. Raja Shekhar for their help and support. I acknowledge help and support received from Mrs. K. Prasanthi as my mentor and well wisher.

I am thankful to the family members of M. Sudhakar for their help, affection and love towards me. I thank Sudhakar once again for his last minute help in dissertation editing stage. I acknowledge help received from Tophan Patra, Dr. Nihar, A. Subrahmanyam, S. Mahapatra and Mr. Dharmender in various capacities from time to time.

I offer my mourning tribute to Mr. Ganapati Chanda (the then Asst. Registrar, Centre for Distance Education, University of Hyderabad), Senthil Kumar (fellow boarder at New Research Scholar Hostel) and K. C. Mahanty (Co-scholar), who were close to me and went heavenly abode untimely during my research career at University of Hyderabad.

Lastly, I would like to thank each and everyone, who directly or indirectly contributed for accomplishing the research work and wish them all a successful life ahead.

Pramod Kumar Mishra

TABLE OF CONTENTS

The Study: Evaluation of Supply Chain Management Practices In Indian Dairy Industry: A Study of Orissa State Cooperative Milk Producers' Federation		**Page No** i
Declaration		ii
Certificate		iii
Acknowledgement		iv
Table of contents		vii
List of tables		xix
List of figures		xxiv
Abbreviations		xxv
CHAPTER - I	**INTRODUCTION**	**01 - 51**
1.1	Global Dairy Industry	02
1.1.1	Dairy farming comparative statistics	03
1.1.2	Milk production	04
1.1.3	Milk production versus availability	06
1.1.4	Dairy processing and trade	07
1.2	Indian Dairy Industry	08
1.2.1	Milk production and per capita availability in India	10
1.2.2	Consumption expenditure on milk	12
1.2.3	Cooperative based dairying in India	13
1.2.4	Dairy cooperative society – milk collection	14
1.2.5	Milk producing members – contributions to societies	15
1.2.6	Milk union - procurement	15
1.2.7	Dairy plants – processing and marketing	15
1.3	Problem Definition	17
1.4	Supply Chain as a Solution to Existing Problems	18
1.5	Introduction to Supply Chain Management	19
1.5.1	Definitions of supply chain	19
1.5.2	Development stages of supply chain	20

1.6			Dairy-Food Supply Chain	21
	1.6.1		Drivers and flows of a dairy food supply chain	22
	1.6.2		Major challenges for dairy food supply chain	23
1.7			Research Gap and Framework	23
	1.7.1		Research questions	25
	1.7.2		Research objectives	25
	1.7.3		Research hypotheses	26
1.8			Data and Methodology	27
	1.8.1		Target population	27
	1.8.2		Target population profile	27
		1.8.2A	Physical and financial achievements of OMFED	31
		1.8.2B	Training programmes	32
	1.8.3		Working population	33
	1.8.4		Sample size and sampling technique	33
		1.8.4A	Sampling and data collection methods	34
		1.8.4B	Geographical distribution of sample	36
	1.8.5		Demographic profile of sample respondents	37
		1.8.5A	Demographic profile of milk producers	37
		1.8.5B	Profile of coop. societies and bulk milk coolers	40
		1.8.5C	Brief profile of production plant	42
		1.8.5D	Profile of transporting agencies	43
		1.8.5E	Demographic profiles of retail agents & customer	43
1.9			Data Analysis	45
	1.9.1		Multiple regression	45
	1.9.2		Factor analysis	47
1.10			Scope of the Research	47
1.11			Limitations of the Research	47
1.12			Chapterization of the Dissertation	47
1.13			References	48
CHAPTER - II			**REVIEW OF LITERATURE**	**52 - 112**
2.1			Introduction to Supply Chain Management	52
	2.1.1		Flows and drivers of a supply chain	53
	2.1.2		Theories supporting supply chain management	55

2.2		Supply Chain versus Logistics	56
2.3		Purchasing in Supply Chain	57
2.4		Dairy farming	59
	2.4.1	Cooperative based dairying	62
2.5		Supply Chain Issues in Dairy Industry	66
	2.5.1	Cost and factors of milk production	67
	2.5.2	Procurement and chilling	68
	2.5.3	Production and distribution	70
	2.5.4	Quality and safety issues	72
2.6		Supply Chain Risk	75
	2.6.1	Supply chain risks in agriculture	79
2.7		Supply Chain Coordination	81
2.8		Supply Chain Performance	88
2.9		Conclusion	100
2.10		References	100
CHAPTER - III		**CONCEPTUAL FRAMEWORK**	**113 - 159**
3.1		Concepts of Supply Chain Management	113
3.2		Supply Chain Cost and Profitability	113
3.3		Types of Supply Chain	115
	3.3.1	The relationship between supply chain types and attributes	117
3.4		Role of Purchasing in Supply Chain	118
	3.4.1	Stages of Purchasing	119
3.5		Concepts of Logistics	120
	3.5.1	Transportation	121
3.6		Major Supply Chain Challenges	122
	3.6.1	Increasingly demanding customers	123
	3.6.2	Fragmentation of supply chain ownership	123
	3.6.3	Globalisation	123
	3.6.4	Difficulty in executing new strategies	123
3.7		Supply Chain Risk Concepts	124
	3.7.1	Risk management	125
	3.7.2	Types of risk	126

3.7.3		Benefits of risk management	127
3.7.4		Risk management process	127
3.8		Supply Chain Coordination	131
3.8.1		Causes of lack of supply chain coordination	131
3.8.2		Patterns of collaboration	132
3.9		Supply Chain Performance	134
3.9.1		Efficiency - in terms of cost and profit	134
3.9.2		Flexibility - the ability to change under a certain circumstance	136
3.9.3		Responsiveness – the ability to react to a certain circumstance	137
3.9.4		Product quality – the ability to provide superior products	137
3.9.5		Process quality – the ability to follow standard operating procedure	138
3.10		Supply Chain Operational Issues in Dairy Ind.	139
3.10.1		Milk producers vs. milk production	139
3.10.2		Factors of milk production	140
3.10.3		Dairy cooperative societies vs. collection of milk	142
3.10.4		Bulk milk coolers vs. chilling & transportation	143
	3.10.4A	Gerber method/milko-tester	144
3.10.5		Production plant and processing	144
3.11		Transporters as Third Party Logistics Providers	145
3.12		Retail Outlets and Sales of Products	146
3.13		Customers and Customer Satisfaction	146
3.14		Dairy Food Supply Chain Models	150
3.15		Conclusion	154
3.16		References	154
CHAPTER - IV		**ONGOING SCM PRACTICES: PROCUREMENT FUNCTIONS**	**160 - 204**
4.1		Dairying Farming and Milk Production	160
4.1.1		Milk production ranges	161
4.1.2		Quality of milk	163

	4.1.3		Household consumption	164
	4.1.4		Sale of milk to societies	164
	4.1.5		Cost of milk production and its influencing factors	165
	4.1.6		Cost of milk production vs. demographic characteristics	167
	4.1.7		Profit and ROI	167
	4.1.8		Cost of milk production vs. ROI	169
	4.1.9		Milk producers' perceptions of dairy cooperative societies	171
	4.1.10		Milk producer level of satisfaction over society participation	172
	4.1.11		Hypotheses at milk producer level	174
4.2			Milk Collection at the Dairy Cooperative Societies	176
	4.2.1		Society operational summary	176
	4.2.2		Milk collection at society	177
	4.2.3		Milk collection vs. field characteristics	178
	4.2.4		Cost price and cost of collection	180
	4.2.5		Sales and selling price (SP)	182
	4.2.6		Profit and ROI	183
	4.2.7		Comparison of primary vs. secondary cost/sales figures	185
	4.2.8		Hypotheses at dairy cooperative society level	185
4.3			Milk Union Ranking in the State of Orissa	186
	4.3.1		Milk chilling at the bulk milk coolers	189
	4.3.2		Procurement of milk vs. other variables	191
	4.3.3		Factors affecting milk marketing (Secondary data sources)	192
	4.3.4		Sales and purchasing	194
	4.3.5		Cost of purchasing	195
	4.3.6		Heads of expense	197
		4.3.6A	Commission of the secretaries	197
		4.3.6B	Remuneration for head loaders and plant operators	198
		4.3.6C	Other expenses	198

4.3.7		Cost of chilling	198
4.3.8		Cost of chilling vs. procurement	199
4.3.9		Cost of chilling vs. various expenses	200
4.3.10		Cost breakup for operational costs	202
4.3.11		Profit and ROI	202
4.3.12		Hypotheses at bulk milk cooler level	203
4.4		Conclusion	204
4.5		References	204
CHAPTER - V		**ONGOING SCM PRACTICES: PRODUCTION AND DISTRIBUTION FUNCTIONS**	**205 - 240**
5.1		Processing at the Production Plant	205
5.1.1		Cost of milk processing	207
5.1.2		Price of various products fixed by the federation/plant	210
5.1.3		Quality and Safety Issues	211
	5.1.3A	Safety issues relating to personnel	211
	5.1.3B	Safety issues relating to machines	212
	5.1.3C	Safety issues relating to materials	212
5.1.4		Sales of various products	213
5.1.5		Dairy-wise milk marketing per day	215
5.1.6		Financial status of the plant	215
5.2		Transportation by Third Party Logistics Providers	216
5.2.1		Pre-requisite for a prospective third party logistics provider	217
5.2.2		Operating cost for transportation	218
5.2.3		Receipts towards transportation cost from plant	218
5.2.4		Distribution process	219
5.3		Milk Sales at Retailer Level	220
5.3.1		Retail operations	221
5.3.2		Sales of various products at retailer level	222
5.3.3		Sales vs. demographics	223
5.3.4		Sales, expenses and profit	224

	5.3.5	Distribution of expenses under various heads	225
	5.3.6	Gross profit ratio (GPR)	226
	5.3.7	Profit vs. investment	227
	5.3.8	Customers' demand fulfilment	228
	5.3.9	Hypotheses at retailer level	229
5.4		Customers as the End Point of the Supply Chain	230
	5.4.1	Purchasing pattern	230
	5.4.2	Consumption and expenditure on dairy products	231
	5.4.3	Expenditure on dairy products vs. demographic profile of customers	232
	5.4.4	Drivers of purchasing the brand	233
	5.4.5	Perception towards price rise	234
	5.4.6	Measuring customer satisfaction	235
	5.4.7	Identification of factors for customer satisfaction	237
	5.4.8	Customer satisfaction index	238
	5.4.9	Hypotheses at customer level	239
5.5		Conclusion	239
5.6		References	240
CHAPTER - VI		**IDENTIFICATION OF RISKS AND THEIR IMPACT ON SUPPLY CHAIN**	**241 – 265**
6.1		Ensuring Existence of Supply Chain Risks	241
	6.1.1	Risks: probability and severity	242
6.2		Description of Risks at Various Level of Supply Chain	242
	6.2.1	Risks at the milk producer level	243
	6.2.2	Risks at the dairy cooperative society level	244
	6.2.3	Risks at the bulk milk cooler level	247
	6.2.4	Risks at the production plant level	248
	6.2.5	Risks at the transporting agency level	250
	6.2.6	Risks at the retail outlet level	251
	6.2.7	Risks at the customers level	252
6.3		Multiple Regression Analysis to Identify Significant Risks	253

	6.3.1	Component-wise model summary of overall risk perceptions	254
	6.3.2	Component-wise risk perceptions	255
6.4		Impact of Risks on Supply Chain	257
	6.4.1	Low milching cattle	258
	6.4.2	Illiteracy of the milk producers	259
	6.4.3	High cost of fodder and medicine	259
	6.4.4	Non-remunerative price of milk	259
	6.4.5	Seasonal fluctuations in production	260
	6.4.6	Lack of leadership skill of secretaries	260
	6.4.7	Low level of milk procurement	260
	6.4.8	Delivery risks	261
	6.4.9	Process/control/quality risks	261
	6.4.10	Logistical risks	262
	6.4.11	Hazard risks	263
	6.4.12	Demand unpredictability	263
	6.4.13	Product shortages	264
	6.4.14	Lack of product reliability	264
	6.4.15	Incompatible price w.r.t quality	264
6.5		Hypotheses Regarding Risks and Uncertainties	265
6.6		Conclusion	265
CHAPTER - VII		**SUPPLY CHAIN COORDINATION AND PERFORMANCE**	**266 - 292**
7.1		Supply Chain Coordination	266
	7.1.1	Milk producer vs. dairy cooperative society interface	266
	7.1.2	Dairy cooperative society vs. bulk milk cooler interface	268
	7.1.3	Bulk milk cooler vs. production plant interface	269
	7.1.4	Production plant vs. transport agency interface	270
	7.1.5	Production plant vs. retail outlet interface	270
7.2		Multiple – Regression Analysis of Coordination Variables	271

7.3			Measuring Degree of Supply Chain Coordination	276
	7.3.1		Internal resources	277
	7.3.2		Trustworthiness	277
	7.3.3		Commitment	277
	7.3.4		Information sharing	278
	7.3.5		Buyer – supplier relationship	278
	7.3.6		Joint decision making	278
7.4			Overall Degree of Coordination	278
7.5			Hypotheses on Supply Chain Coordination	279
7.6			Supply Chain Performance Measurement	279
	7.6.1		Evaluating performance of a milk producer	283
		7.6.1A	Facility costs (cost of milk production)	283
		7.6.1B	Return on investment	283
		7.6.1C	Delivery flexibility	284
		7.6.1D	Fill rate	284
		7.6.1E	Product reliability	284
		7.6.1F	Working conditions	285
7.7			Evaluating Performance of Supply Chain	286
	7.7.1		Efficiency	286
	7.7.2		Flexibility	288
	7.7.3		Responsiveness	288
	7.7.4		Product quality	289
	7.7.5		Process quality	289
	7.7.6		Component-wise performance	289
7.8			Supply Chain Performance Based on Indicators, Risks & Customer Satisfaction	290
7.9			Hypotheses for Supply Chain Performance	291
7.10			Conclusion	292
CHAPTER - VIII			**SUMMARY AND CONCLUSION**	**293 – 329**
8.1			Milk Producers as Suppliers	293
	8.1.1		Man-woman participation in dairy farming	293
	8.1.2		Main vs. subsidiary occupations	293
	8.1.3		Participation at the societies	294

8.1.4		Driving forces of society participation	294
8.1.5		Milk production and seasonal variations	294
8.1.6		Range of milk production	295
8.1.7		Factors affecting level of milk production	295
8.1.8		Quality of milk produced	295
8.1.9		Factors of cost of milk production	296
8.1.10		Cost of milk production	296
8.1.11		Variables affecting cost of milk production	296
8.1.12		Household milk consumption and sales	297
8.1.13		Profit and ROI	298
8.1.14		Variables affecting profit and ROI	298
8.1.15		Level of satisfaction being with the supply chain	299
8.2		Dairy Cooperative Societies	299
8.2.1		DCS organisation and membership	299
8.2.2		Reason behind DCS formulation	300
8.2.3		Years of operation and coverage area of a DCS	300
8.2.4		Member -waiting time for delivery	300
8.2.5		Milk collection – quantity vs. quality	300
8.2.6		Factors affecting level of milk collection	301
8.2.7		Average delivery of a producer-member	301
8.2.8		Cost price of milk	302
8.2.9		“Factors and cost” of milk collection	302
8.2.10		Sales and receipts	302
8.2.11		Profit and ROI	303
8.3		Bulk Milk Coolers	304
8.3.1		Infrastructural status and processing capacity	304
8.3.2		BMC operational area	304
8.3.3		Procurement of milk and capacity utilisation	304
	8.3.3A	Factors affecting procurement level	305
8.3.4		Cost of purchasing	305
8.3.5		Sales turnover and selling price	305
8.3.6		Cost of chilling and transportation	306
8.3.7		Profit and ROI	306

8.4			Production Plant	306
	8.4.1		Capacity utilisation vs. milk procurement	306
	8.4.2		Cost of processing	307
	8.4.3		Quality and safety issues	307
	8.4.4		Transportation by third party logistics providers	307
		8.4.4A	Operating cost and receipts for transportation	308
	8.4.5		Sales and profit	308
8.5			Retail Operations	308
	8.5.1		Retailer operational area	309
	8.5.2		Sales of dairy products:	309
		8.5.2A	Sales, expenses and profit	309
		8.5.2B	Factors affecting retail sales	310
	8.5.3		Retail fill-rates	310
8.6			Customers: The End Users	310
	8.6.1		Per capita milk consumption	311
	8.6.2		Factors affecting expenditure on milk	311
	8.6.3		Driving forces of brand purchase	311
	8.6.4		Customer satisfaction	312
8.7			Supply Chain Cost and its Underlying Factors	312
8.8			Supply Chain Profitability	313
8.9			Identification and Assessment of Supply Chain Risks	314
	8.9.1		Risk Grid	315
	8.9.2		Impact of high risks on supply chain	315
	8.9.3		Impact of medium risks on supply chain	317
	8.9.4		Impact of low risks on supply chain	318
8.10			Strategies to Combat High Risks	318
8.11			Supply Chain Coordination	320
8.12			Supply Chain Performance	321
8.13			Supply Chain Summary	323
8.14			Results of Hypotheses Framed	323
8.15			Comparing Dairy Federations in India	325
	8.15.1		Top performing dairy federations in various fields	325

8.15.2	Ranking of dairy federations	325
8.16	Suggestions and Recommendations	326
8.17	Direction for Future Research	329
8.18	Conclusion	329
BIBLIOGRAPHY		**330 - 338**
APPENDICES	Appendix A1: Questionnaire for the Milk Producers (MP)	
	Appendix A2: Questionnaire for the Dairy Cooperative Societies (DCS)	
	Appendix A3: Questionnaire for the Bulk Milk Coolers (BMC)	
	Appendix A4: Questionnaire for the Production Plant Officials (PP)	
	Appendix A5: Questionnaire for the Transporting Agencies (TA)	
	Appendix A6: Questionnaire for the Retail Outlets (RO)	
	Appendix A7: Questionnaire for the Customers (CUS)	
	Appendix A8: Photos taken from the field	
PUBLICATIONS	Appendix A9	

LIST OF TABLES

Table No		Description of the Table	Page No
1.1		Comparative statistics of dairy farms across the globe	03
1.2		Top ten countries' cattle-wise milk production (million tonnes)	04
	1.2A	Country-wise milk production and per capita availability	06
1.3		World production & trade of dairy products (million tonnes)	07
	1.3A	Major exporters of dairy products in the world	08
1.4		Share of agriculture and livestock sector in GDP in India	09
1.5		State-wise milk production and per capita availability	11
1.6		Per capita monthly consumption expenditure on milk	12
1.7		Comparative statistics of dairy federations in India	16
	1.7A	Operational summary of dairy federations in India	16
1.8		List of research hypotheses framed	26
1.9		Funds released versus milk production: India vs. Orissa	28
1.10		Physical achievements-I of OMFED	31
1.11		Physical achievements-II OMFED	31
1.12		Financial achievements of OMFED	32
1.13		Proposed vs. actual sample of research	33
	1.13A	Sampling & data collection methods (First category respondents)	34
	1.13B	Tehsil - wise distribution of first category respondents	36
	1.13C	Distribution of second category respondents	37
1.14		Demographic profile of milk producers	38
1.15		Profile of cooperative societies and bulk milk coolers	41
1.16		Profile of production plant	42
1.17		Profile of third party logistics providers	43
1.18		Demographic profile of retail agents and customers	44
2.1		Theories supporting supply chain management	56
2.2		Green and dry fodder shortages in India	61
2.3		Distinctions among various quality standards	73
2.4		Supply chain performance models	92
3.1		Lean vs. Agile supply chain	116

3.2		LARG versus synergies and divergences	117
3.3		History of purchasing	118
3.4		Logistics costs breakup	121
3.5		Patterns of collaboration	132
3.6		Calculating cost of milk production	141
4.1		Distribution of milk production ranges	161
	4.1.1	Milk production, quality level, consumption and sales per day	163
4.2		Factors of milk production	165
	4.2.1	Cost of milk production vs. demographic characteristics	167
4.3		Profit and ROI of milk producers	168
	4.3.1	Cost of milk production vs. ROI	169
	4.3.2	ROI vs. operational factors	170
4.4		Society perceptions of milk producers	171
	4.4.1	Rotated component matrix of society perceptions	172
4.5		Model validation: milk producer satisfaction on society	172
4.6		ANOVA: milk producer satisfaction on society	173
4.7		Regression coefficients: milk producer satisfaction on society	173
4.8		Weightage and mean scores of driving forces of society	174
4.9		ANOVA of all hypotheses at milk producer level	175
4.10		DCS operational summary	176
	4.10A	DCS operational summary (continued)	177
4.11		Milk collection at society	178
	4.11.1	Milk collection vs. field characteristics	178
	4.11.2	ANOVA for milk collection vs. field characteristics	179
	4.11.3	Regression coefficients for milk collection vs field characteristics	179
4.12		Cost price (CP) and cost of collection (CC)	181
4.13		Milk sales, receipts and selling price at society level	182
4.14		Profit, assets and ROI at society	183
4.15		One-sample t – tests for comparing cost and sales at society	185
4.16		Comparative statistics of milk unions in Orissa	187
4.17		Year-wise milk unions' performance on various opera. indicators	188
	4.17A	Ranking of milk unions on existing infrastructure	188
4.18		Capacity vs. set up expenditure of bulk milk coolers	189

4.19		Operational summary of bulk milk coolers	189
	4.19A	Operational summary of bulk milk coolers (continued)	190
4.20		Model summary of procurement vs. operational characteristics	191
4.21		ANOVA of procurement vs. operational characteristics	191
4.22		Regression coeff. of procurement vs. operational characteristics	192
4.23		Model summary: federations' milk marketing	193
4.24		ANOVA: federations' milk marketing	193
4.25		Regression coefficients: federations' milk marketing	193
4.26		Procurement and sales of bulk milk coolers	195
4.27		BMC-wise financial transactions	196
	4.27.1	Milk purchasing cost at bulk milk cooler	197
4.28		Cost of chilling and profit per litre	198
	4.28.1	Cost of chilling vs. procurement	199
	4.28.2	Model summary of chilling cost vs. other expenses	200
	4.28.3	ANOVA for chilling cost vs. other expenses	201
	4.28.4	Regression coefficients of chilling cost vs. other expenses	201
4.29		Operational cost breakup at bulk milk coolers	202
4.30		Profit and ROI of bulk milk coolers	203
5.1		Capacity utilisation of plant machineries	205
5.2		Procurement vs. marketing at production plant	206
5.3		Cost of processing per litre (Toned milk)	207
5.4		Cost of production of various dairy products	209
5.5		Prices of dairy product and profit at retailer level	210
5.6		Year-wise sales of dairy products at production plant	213
	5.6.1	Route-wise distribution of milk	214
5.7		Dairy-wise milk marketing per day	215
5.8		Assets and liabilities of the production plant	216
5.9		Factors affecting transporting cost	218
5.10		Vehicle categories with their price/km	219
5.11		Route-wise milk distribution	220
5.12		Retailing summary	221
5.13		Sales of various products per day	222
	5.13.1	Correlation between sales and demographic characteristics	223

5.14		Sales, expenses and profit at retailer level	224
5.15		Distribution of mean expenses under different heads	226
5.16		Calculating gross profit ratio for various products	226
5.17		Paired sample t-test for investment vs. profit	227
5.18		Fill rates of retailers	228
5.19		Customers' purchasing pattern of milk vs. monthly income	230
5.20		Per capita consumption and expenditure on dairy products	231
	5.20.1	Correlation of expenditure on dairy products vs. demographics	232
5.21		Driving forces of brand purchase	233
5.22		Opinions of customers on various brand parameters	236
	5.22A	Rotated component matrix of various items of customer satisfact.	237
5.23		Quantifying customer satisfaction	238
6.1		Ensuring existence of supply chain risks	241
6.2		Milk producers' opinions on various risks	244
6.3		Society secretaries' opinions on various risks	245
6.4		BMC Plants-in-charge Opinions on various risks	247
6.5		Risk scores at the production plant level	249
6.6		Risk scores at transporting agency level	250
6.7		Retailers' opinions on various risks	251
6.8		Customers' opinions on various risks	253
6.9		Component-wise coefficients of determination for risks	254
	6.9A	ANOVA - various components' risk perceptions	255
	6.9B	Regression statistics of independent risk variables	256
7.1		Opinions on coordination for MP - DCS interface	267
7.2		Opinions on coordination for DCS - BMC interface	268
7.3		Opinions on coordination for PP - RO interface	271
7.4		Model summary of all interfaces regarding coordination	272
7.5		Combined ANOVA results of all interfaces	273
7.6		Procurement - production coordination coefficients	274
7.7		Production - distribution coordination coefficients	275
7.8		Interface - wise degree of coordination	276
7.9		Model fitting of performance measures	280
7.10		ANOVA supporting the performance models	281

7.11		Indicator-wise coefficients and tolerances	282
7.12		Performance measurement of an individual milk producer	285
7.13		Sub-indicator wise supply chain performance measurement	287
	7.13A	Indicator wise performance measurement of various components	288
7.14		Supply chain performance summary	291
8.1		Cost of processing at plant level	307
8.2		Supply chain cost	312
8.3		Supply chain profitability	314
8.4		Summary and strategies to combat high risks in dairy industry	319
8.5		Inferences of hypotheses	324
8.6		Overall ranking of dairy federations on various parameters	326

LIST OF FIGURES

Figure No	Description of the Figure	Page No
1.1	Traditional dairy food supply chain	21
1.2	Research framework	24
1.3	Map of Orissa	29
1.4	OMFED at a glance	30
2.1	Drivers of supply chain	54
2.2	Steps in optimally coordinated supply chain	84
2.3	Benchmarking wheel	91
3.1	Flow chart of risk management process	128
3.2	Measuring supply chain coordination	133
3.3	Country-wise cost of milk production	140
3.4	Kano’s model of customer satisfaction	148
3.5	Moldova (Russia) dairy food supply chain	150
3.6	Australian dairy food supply chain	151
3.7	Ethiopian dairy food supply chain	152
3.8	European dairy food supply chain	153
4.1	Dairy farming vs. society experience	161
4.2	Milk production vs. fodder expenditure	162
4.3	Milk production vs. cost	166
4.4	Milk production vs. profit	169
4.5	Cost of collection	181
4.6	Variation of chilling cost w.r.t level of procurement	200
5.1	Factors of cost of production for dairy products	208
5.2	Retail investment vs. net profit	228
5.3	Income vs. expenditure on dairy products	233
5.4	Customers’ perception towards price rise	234
6.1	Cost of production vs. milk quantity	258
7.1	Opinions on coordination for BMC - PP interface	269
7.2	Opinions on coordination for PP - TA interface	270
8.1	Risk grid for dairy industry	315

ABBREVIATIONS

3PL	---	Third Party Logistics
4PL	---	Fourth Party Logistics
AH&DF	---	Animal Husbandry, Dairying & Fisheries
AHP	---	Analytic Hierarchy Process
AI	---	Artificial Insemination
ANOVA	---	Analysis of Variance
APDDCF	---	Andhra Pradesh Dairy Development Cooperative Federation Ltd.
APICS	---	Advancing Productivity Innovation Competitive Success
Av	---	Average
B2B	---	Business to Business
B2C	---	Business to Customers
BBAMUL	---	Balasore - Bhadrak Milk Union Ltd.
BMC	---	Bulk Milk Cooler
BMS	---	Butter Milk Sip
BPR	---	Business Process Re-engineering
BSC	---	Balanced Score Card
BSR	---	Bio-Supply Relationship
C2B	---	Customers to Business
CAGR	---	Compounded Annual Growth Rate
CC	---	Chilling Centre
CE	---	Concurrent Engineering
CII	---	Confederation of Indian Industries
CLR	---	Correct Lactometer Reading
CMB	---	Common Method Bias
CMP	---	Clean Milk Production
CMU	---	Cuttack Milk Union
COMPFED	---	Bihar State Cooperative Milk Producers' Federation Ltd.
CP	---	Cost Price
CPFR	---	Collaborative Planning, Forecasting and Replenishment
CRM	---	Customer Relationship Management
CSO	---	Central Statistical Organization

CUS	---	Customers
CV	---	Coefficient of Variation
DCS	---	Dairy Cooperative Society
df	---	Degrees of Freedom
DRDA	---	District Rural Development Agencies
ECR	---	Efficient Consumer Response
EEC	---	European Economic Community
EIAS	---	Enterprise-wide Integrated Application System
EMD	---	Earnest Money Deposit
ERP	---	Entrepreneur Relationship Planning
EU	---	European Union
EXIM	---	Export and Import
F&M	---	Fodder and Medicine
FAO	---	Food and Agriculture Organisation
GCMMF	---	Gujarat Cooperative Milk Marketing Federation Ltd.
GDP	---	Gross Domestic Products
Gm(s)	---	Gram(s)
GMP	---	Good Manufacturing Practice
GOI	---	Government of India
Govt	---	Government
GPR	---	Gross Profit Ratio
GPS	---	Global Positioning Systems
GXP	---	Good X Practice codes
HACCP	---	Hazard Analysis and Critical Control Points
HDDCF	---	Haryana Dairy Development Cooperative Federation Ltd.
HPSCMPF	---	Himachal Pradesh State Cooperative Milk Producers' Fed. Ltd.
HSC	---	High School Certificate
ICAR	---	Indian Council of Agricultural Research
ICT	---	Information and Communication Technology
IDDP	---	Integrated Dairy Development Project
IFCN	---	International Farm Comparison Network
ISCM	---	Internal Supply Chain Management
ISO	---	International Standardisation Organisation systems

IT/IS	---	Information Technology/System
JIT	---	Just-in-Time
KCMMF	---	Kerala State Cooperative Milk Marketing Federation Ltd.
Kg(s)	---	Kilogram(s)
Km(s)	---	Kilometre(s)
KMF	---	Karnataka Cooperative Milk Producers' Federation Ltd.
KPIs	---	Key Performance Indicators
LARG	---	Lean, Agile, Resilient and Green
LPD	---	Litres per Day
Lt(s)	---	Litre(s)
MAMUL	---	Mayurbhanj District Cooperative Milk Producers’ Union Ltd
MBO	---	Management by Objective
MDC	---	Men Dairy Cooperative Societies
MILKFED	---	Punjab State Cooperative Milk Producers' Federation Ltd.
Ml(s)	---	Millilitre(s)
MMPO	---	Milk and Milk Product Order
MoS&PI	---	Ministry of Statistics and Programme Implementation
MP	---	Milk Producer
MPCDF	---	Madhya Pradesh State Cooperative Dairy Federation Ltd.
MRP	---	Maximum Retail Price
MRSDMM	---	Maharashtra Rajya Sahakari Dugdh Mahasangh Maryadit
MT	---	Metric Tonne (1,000 kgs)
NCAER	---	National Council of Applied Economic Research
NDDB	---	National Dairy Development Board
NFC	---	Non-Fibre Carbohydrate
NGC	---	New Generation Cooperatives
NIRD	---	National Dairy Research Institute
Nos	---	Numbers
NSSO	---	National Sample Survey Organization
OECD	---	Organisation for Economic Cooperation and Development
OFP	---	Operation Flood Program
OFR	---	Order Fill Rate
OMFED	---	Orissa State Cooperative Milk Producers' Federation Ltd.

PCDF	---	Pradeshik Cooperative Dairy Federation Ltd. (Uttar Pradesh)
PFR	---	Product Fill Rate
PMP	---	Preventive Maintenance Programme
POS	---	Point of Sale
PP	---	Production Plant
PPM	---	Part per Million
PPP	---	Public Private Partnership
PUMUL	---	Puri Milk Union Ltd.
Pvt	---	Private
QFD	---	Quality Function Deployment
R&D	---	Research and Development
RCDF	---	Rajasthan Cooperative Dairy Federation Ltd.
RFID	---	Radio Frequency Identification
RKVY	---	Rashtriya Krishi Vikash Yojana
RO	---	Retail Outlet
ROI	---	Return on Investment
Rs	---	Rupees
SC	---	Supply Chain
SCC	---	Supply Chain Coordination
SCCI	---	Supply Chain Coordination Index
SCI	---	Supply Chain Indicator
SCM	---	Supply Chain Management
SCOR	---	Supply Chain Operations Reference
SCP	---	Supply Chain Performance
SCR	---	Supply Chain Risk
SCRCOP	---	Supply Chain Risk Coping
SE	---	Simultaneous Engineering
SERVQUAL	---	Service Quality
SFM	---	Skimmed Flavoured Milk
SGSY	---	Sampurna Grameen Sworojgar Yojana
SHG	---	Self Help Group
SMP	---	Skimmed Milk Powder
SNF	---	Solid-Not-Fat

SP	---	Selling Price
SPSS	---	Statistical Package for Social Sciences
SRM	---	Supplier Relationship Management
TA	---	Transport Agency
TCMPF	---	Tamil Nadu Cooperative Milk Producers' Federation Ltd.
TKgPD	---	Thousand Kilograms per Day
TLPD	---	Thousand Litres per Day
TMS	---	Total Milk Solids
TPLP	---	Third Party Logistics Providers
TQM	---	Total Quality Management
UHT	---	Ultra High Temperature
UNFAO	---	United Nations Food and Agriculture Organisation
USD	---	U.S Dollars
VAT	---	Value Added Tax
VICS	---	Voluntary Inter-industry Commerce Standards
VIFs	---	Variance Inflation Factors
VMI	---	Vendor Managed Inventory
w.r.t	---	With respect to
WB	---	West Bengal
WBCMPF	---	West Bengal Cooperative Milk Producers' Federation Ltd.
WBS	---	Work Breakdown Structure
WDCS	---	Women Dairy Cooperative Societies
WHO	---	World Health Organisation
WIP	---	Work-in-Progress
WMC	---	Whole Milk Curd
WMP	---	Whole Milk Powder
WW I	---	World War I
WW II	---	World War II

CHAPTER I

INTRODUCTION

The dairy industry plays a crucial role in agro-based economy of a country providing ample scope to the rural people to earn extra money in their leisure time. The industry is extended from the milk producers in the rural areas to the consumers in the urban areas through performing various interim processes like collection, chilling, transportation, pasteurisation, distribution etc. The main sources of supply are the milk producers in the rural and sub-urban areas that are the scattered, low capacitated and independent in the approach. There is no binding on them to demand a continuous supply of materials (milk) for a specific period of time. They are free to enter and leave the system which in turn affects the procurement and other operations in the long run. However, the industry in the developing or under-developed countries by and large depends upon this system of procurement to be a going concern.

Low milk price, lack of subsidies, high cost of feed and fodder etc. give rise to high cost of milk production and lower earnings (Prasad, 2005; Rao & Sharma, 2003; Saravanakumar & Jain, 2008; FAO, 2007). So, ultimately dairy farming as a profession is not being continued in the organised sector especially and brings up a high rate of milk producer attrition. As a repercussion, milk collection at society and union level gets affected which in turn becomes a critical factor for the production/processing at the plant level. Sub-optimal level of collections leads to higher chilling-, transportation- and processing costs and decreases profit at various stages of operation (Barman, Konwar, & Kumar, 2008).

On the distribution side, the customers' perception of quality, price, time and flexibility has been changing continuously. Today, they are highly informed and hence conscious about the quality of the product or service. Keeping view to the customers' changing demand pattern, firms are modifying their operational modalities to improve quality of the products and services while improving the speed of delivery. In both cases performing as per the schedule is very crucial. Simultaneously, the flexibility in the procurement, production and distribution is another major concern in dealing with the upstream and downstream players. So to sum up at the distribution side of the industry, delivery speed, quality, price-quality compatibility are some of the major issues to deal with (Juran, 1988; Teng & Jaramillo, 2005; Ramaiah, 2008).

Apart from the aforesaid issues the industry often gets affected by the risks and uncertainties during various stages of the operations. While some of the risks and uncertainties are easy to detect, some are not easy to detect, but in both the cases these obstruct the operations and lead to lowering down of profit. These sometimes come up due to lower degree of vertical coordination among the stakeholders in the system. The decisions taken unilaterally bring in conflicting situations where the system-wide profit and Return on Investment (ROI) are dominated by individual gains. To deal with all such problems relating to procurement, production and distribution a clear-cut organisational policy, high degree of vertical integration and measurement of performance of stakeholders on regular interval of time are inevitable in the long run.

The discussion henceforth is on the global and Indian scenario of dairy industry followed by problem definition and rationale behind using supply chain concepts.

1.1 Global Dairy Industry

Dairy industry which provides livelihood to the hundreds of millions of people across the globe perhaps is the most distorted agriculture sector. The industry is a complex bonding of several stakeholders where the most important stakeholder is the milk producers who stay in the rural areas and produce milk with the help of low milching cows. Comparing to the developed countries, where the corporatisation of dairying is quite prevalent, the developing country scenario is completely different.

In the developing countries, the dairy industry is dependent upon the small and marginal milk producers with one to two cows especially in countries like India and Pakistan. Though herd size in India and Poland is almost similar still the milk production per cow per year is drastically lesser in the former. It has been seen that, a cow in Poland produces almost 4,000 kgs per year against an Indian cow's milk production of only 665 kgs per year – one sixth of the former case (ICAR, 2009). While in some of the countries the sector is subsidised, in most of the countries the whole onus vested with the small and marginal producers to produce good quality milk. Not only this, due to cheaper products available out of the imports made the selling of quality milk and allied products become extremely difficult encouraging the stopping of milk production and farm liquidation in some cases. Irrespective of this, the world dairy industry is rising at an average rate of 3.0 percent annually and has been valued at USD 19 billion today (World market, 2008-11).

1.1.1 Dairy farming comparative statistics

The table 1.1 portrays the comparative statistics of the world dairy farms. The highest dairy cows as stated earlier are seen to be in India followed by USA, New Zealand and France. On the contrary, the highest number of dairy farms is located in India and Poland where the average herd size of a farm is 2 and 5 respectively. An average herd size of New Zealand is as high as 333 followed by USA, South Africa, UK and Slovak Republic. As far as milk production per cow per year is concerned, it is the USA which has turned down other countries in the world with 9,353 kgs. UK, Canada, Denmark and Asian countries like Japan have got average milk production of 8,000 kgs per cow per year.

Table 1.1: Comparative statistics of dairy farms across the globe

Country	Dairy cows (nos)	Dairy farms (nos)	Herd size (nos)	Production /cow/year (kgs)	Fat & protein (percent)	Calving interval (days)	Lactation period (days)	Producers' price (percent)
USA	9,201,000	54,942	167	9,353	6.76	-	305	100.00
UK	716,107	4,782	150	9,090	7.30	423	361	100.00
Denmark	560,000	4,300	130	8,700	7.73	-	365	100.00
Canada	978,400	13,214	74	8,458	7.08	433	305	88.00*
Japan**	955,393	21,368	44	8,116	7.26	432	360	63.80*
France	3,793,600	86,000	44	6,623	7.64	416	338	100.00
Slovak Republic	162,485	1,236	131	5,770	7.06	428	296	36.70 (decreasing)
South Africa	535,500	3,458	155	4,975	7.33	421	330	34.00* (decreasing)
Poland	2,606,094	486,470	5	3,828	7.25	427	305	62.00 (increasing)
New Zealand**	4,112,487	11,930	333	3,820	8.30	368	222	100.00

Source: www.icar.org.in (2009) (*2002, **forecast)

Being the highest milk producer in the world, the average milk production per cow per year in India is significantly lesser than the developed countries (e.g. 665 kgs only). This may be noted that it has also got the highest livestock population of more than 60 million with an average herd size of two or three. While in most of the countries the dairy industry is not subsidised and the cost is borne by the concerned stakeholder, it is subsidised in Canada, Japan, Slovak Republic, South Africa and Poland. But the trend of providing subsidy is found to be declining over a period of years except Slovak Republic and South Africa.

In spite of the low herd size in Poland, the subsidy is shrinking major part of the cost is being borne by corresponding stakeholders. A similar situation is felt in India where a little provision is there to provide subsidised feed and fodder to the milk producers in the cooperative based dairying. Aryshire, Brown Swiss, Guernsey, Holstein, Jersey, Milky Shorthorn are very common kind of cattle reared in many countries. In developing countries like India crossbred is quite popular but found to be less productive for dairying.

1.1.2 Milk production

Table 1.2: Top ten countries' cattle-wise milk production (million tonnes)

Countries	Cows	Buffalos	Goats	Sheep	Camels	Total
India	43.48	55.91	3.89	0.00	0.00	103.28 (25.7)
USA	84.19	0.00	0.00	0.00	0.00	84.19 (20.9)
China	35.57	2.90	0.26	1.07	0.01	39.82 (9.9)
Pakistan	11.13	20.37	0.68	0.00	0.00	32.18 (8.0)
Russian Federation	31.91	0.00	0.26	0.00	0.00	32.17 (8.0)
Germany	28.40	0.00	0.00	0.00	0.00	28.40 (7.1)
Brazil	26.94	0.00	0.14	0.00	0.00	27.08 (6.7)
France	24.37	0.00	0.57	0.27	0.00	25.21 (6.3)
New Zealand	15.62	0.00	0.00	0.00	0.00	15.62 (3.9)
UK	14.02	0.00	0.00	0.00	0.00	14.02 (3.5)
Total	315.65	79.19	5.80	1.34	0.01	401.99 (100.0)

Source: www.fao.org (2009)

In total 58 percent of the milk production comes from the countries mentioned in the above table wherein respectively 78 percent and 20 percent of the milk production is attributed to the cows and buffaloes. Goat and sheep together contribute another two percent where camel is rarely kept for milk production activities. Among the top 10 countries it is found only in case of China and among top 20 countries it is seen mostly in case of the Arabian countries. A similar kind of trend is also seen in case of buffaloes which are not greatly adopted in the developed countries excepting Asian countries like India, Pakistan and China. Among the developing countries India's contribution to the top 10 counties' milk production is around 26 percent while it is more than 15 percent to the world milk production (FAO, 2009).

The global milk production in the year 2009 is found to be 699 million tonnes backed by a growth rate of 1.1 percent over 2008, comparing to the usual growth rate of 2.0 percent annually (FAO, 2010). The developing country's share of global milk production is found to be more than 48 percent which was around 40 percent a decade ago. Milk production level of the world's top exporters has deteriorated and remains stagnant during 2008 to 2009 at 273 million tonnes. In most part of the world the production is also hampered due to soaring feed and fodder prices and improper pasture conditions (FAO, 2009).

The United States being one of the major milk production hubs might lead to shrink because of the low profitability and herd liquidation of farms. Hence the milk production is now expected to fall to 85.5 million tonnes in the year 2009. During the last seven years of its growth period the sector had gained increasing market share across the globe. Due to the poor demand conditions in Canada, the production may come down to 8.3 million tonnes indicating a lower rate of production comparing to the previous year.

Production in the developing countries is expected to expand the most, thus increasing their global production share to 47.5 percent. India is the largest producer in the world producing over 100 million tonnes of milk and is said to be "The Oyster" of the global dairy industry. It has got the largest livestock population with 134 million cows and 125 million buffaloes which contribute to 15 percent of world milk production (FAO, 2007). Moreover the production cost of milk is quite competitive in the world. India surpassed the United States in 1998 with a production of 92 million tonnes of milk to become the global leader in the field. It is estimated that milk production in India will reach 111 million tonnes by 2010 (Our Bureau). Milk production is expected to rise by 3.5 percent in Asia by making it to 256 million tonnes. Irrespective of the China's melamine crisis the production is expected to rise by as high as 6.0 percent this year against India's growth rate of only 2.8 percent. Pakistan is also found to be following the footprint of China to make it up to 6.0 percent of growth rate.

Under unprofitable conditions the European Union's (EU-27) milk production have started to decline in late 2008 and is anticipated to come down to 150.9 million tonnes during

2009. The fall in milk production might decrease exportable surplus of milk products by almost one million tonnes in 2009 as compared to the last year. New Zealand's milk production could reach to 16.2 million tonnes in 2008-09 which will help the country to keep its track of being the world's largest exporter of milk products.

1.1.3 Milk production versus availability

Per capita availability of milk decreases significantly with the population of a country. Higher is the population lesser is the availability of milk. Some of the major countries milk production and their availability to the consumer have been stated hereunder. It is detected that the global per capita availability of milk is around 237 gms per day (Organisation for Economic Cooperation and Development, 2009).

Table 1.2A: Country-wise milk production and per capita availability

Countries	Milk production ('000 tonnes)				Per capita availability (gms/day)			
	2005	2006	2007	2008	2005	2006	2007	2008
European Union	149,002	148,360	147,892	149,150	841	886	834	841
North America	88,060	90,504	92,334	94,319	727	740	748	756
Asia Others	76,907	80,813	84,715	86,183	129	133	137	138
*CSAC	68,060	70,940	72,104	74,839	334	344	345	354
EU Others	60,615	60,641	60,562	60,529	686	689	692	695
South East Asia	40,954	45,299	48,552	48,837	54	59	63	63
Oceania	24,830	25,327	25,268	24,507	2,091	2,110	2,082	1,998
Africa	23,861	25,014	24,168	27,276	74	76	72	79
Asia Middle East	10,787	11,484	12,364	12,364	153	159	168	164
World	543,076	558,383	570,960	578,004	231	234	237	237

Source: www.oecd.org, *Central South America and Caribbean

It can be seen from the table 1.2A that, the ratio of production and availability is constant during 2005-08 as both population and the milk production are having upward trends. During the year 2008 the milk availability is found to be the highest in case of Oceania and on the lower side of the per capita milk availability curve Asia and Africa are seen. The per capita availability of milk in South East Asia and Africa are respectively found to be 63 gms and 79 gms per day. In case of other countries in Asia (excepting South Asian countries), 138 gms per day milk is available for its consumers. Being one of the highest populous countries in the world, India's case is found to be little ahead of world average i.e. 258 per day gms (Department of Animal Husbandry and Dairying, GOI, 2009).

1.1.4 Dairy processing and trade

IFCN (2009) has considered 605 milk processing companies from 69 countries who represent 91 percent of total milk delivered world-wide. New Zealand's Fonterra, USA's Dairy Farmers of America and Switzerland's Nestle are the top runners in dairy processing segment in the world. India's Amul being at the 21st position processes only 0.4 percent of the India's total milk production for various dairy products.

Table 1.3: World production & trade of dairy products (million tonnes)

Production vs. Trade	2007	2008 (estimated)	2009 (forecast)	Growth (percent)
Skimmed Milk Powder (SMP) production	24.1	24.6	25.0	1.6
Whole Milk Powder (WMP) production	30.8	31.6	32.1	1.6
Butter production	60.3	62.3	64.0	2.7
Cheese production	85.9	87.9	89.8	2.2
Other products	475.1	481.3	488.0	1.4
Total trade	39.4	39.7	39.4	-0.8
Trade vs. production (percent)	5.8	5.8	5.6	-

Source: FAO Statistics (2009)

Production of milk as well as other products is on constant rise across the globe but when it comes to trade, the figures are quite discouraging. Over a period of last three years as mentioned in the table - it can be seen that the traded quantity is about six percent of total production in milk equivalent terms (table 1.3). In the year 2008 the growth rate is found to be negative (-0.8 percent). Due to the higher perishability nature of liquid milk, the trade has been a difficult affair unlike milk powder, SMP, WMP etc. The poor statistics could be also attributed to the weak demand conditions for the milk products. Global exports of key milk products (in milk equivalent terms) are forecasted to decline to 39.4 million tonnes in 2009 which is lesser by 0.3 million tonnes from the estimate of 2008. The decline is due to the significant reduction of export by United States and the European Union. Lower exports by these countries are expected to be offset by Oceania with its increased deliveries possibly by 1.2 million tonnes. At the same time Brazil may also increase its shipments to compensate the gap in export. Exports from the countries like

India and China seem to be stagnant, who basically export to other Asian countries. Due to the adverse market conditions and economic recession currently, it is presumed that the investment in the dairy market might decline. Furthermore due to the slowdown economy of the importing countries the export market might shrink as the consumption of dairy production mostly depend upon the purchasing power of the consumers. Russian Federation being the largest importer of dairy products is going to import lesser quantity of milk products due to its slowdown economy where the gross domestic product is slashed by 6 percent in 2009 comparing to the last year.

Table 1.3A: Major exporters of dairy products in the world ('000 tonnes)

Countries	WMP	SMP	Butter	Cheese	Total
New Zealand	686	278	338	284	1,586 (28.0)
European Union	386	180	150	536	1,252 (22.0)
Australia	109	115	58	215	497 (9.0)
United States	0	350	0	0	350 (6.0)
Belarus	0	0	60	110	170 (3.0)
Argentina	107	0	0	0	107 (2.0)
Total	1,288	923	606	1,145	3,962 (71.0)
World	1,826	1,186	798	1,776	5,586 (100.0)

Source: Compiled from FAO & IFCN statistics (2009)

The aforesaid countries are responsible for more than 71 percent of the total dairy exports of the world. New Zealand and European Union respectively contribute to 28 percent and 22 percent respectively. It can be further seen that for the individual products these countries contribute on an average 70 percent to the world export market. United States and Argentina only contributes to the SMP and WMP sector of the world dairy market. Despite being the largest producer of milk in the world, India is lagging behind in the trading sector.

1.2 Indian Dairy Industry

Indian economy by and large depends upon agriculture where 70 percent of the people are related to the agricultural related professions and almost half of their income comes from activities like dairy and poultry farming (Ashok Kumar & Sayulu, 2007). Agriculture together with the dairy industry accounts for 16.6 percent of total Gross Domestic Product

(CSO, GOI, 2009). But over a period year the GDP both from agriculture and dairy farming are found to be deteriorating as is seen from the table 1.4. During 2003-04 to 2007-08 the GDP from agriculture has come down by four percent at current prices. Similarly the GDP from livestock sector has come down by 0.26 percent at current prices which reveals the lower level of productions in the sector over a period of just five years. The major causes of this could be diverting from traditional crop cultivation to commercial cultivations and migration of rural people to the urban areas in search of jobs. The flair for agriculture in the rural areas are also lacking due to low profit and difficulty in selling traditional crops or animal products like milk. However the deteriorating trend is giving rise to the higher inflation making a common man's life a difficult one.

Table 1.4: Share of agriculture and livestock sector in GDP in India

Year	GDP Total* (Rs. billion)	GDP (Agriculture sector)		GDP (Livestock sector)	
		Rs. billion	Share (%)	Rs. billion	Share (%)
2003-04	25,382	4,830	19.03	1,183	4.66
2004-05	28,777	5,014	17.42	1,361	4.73
2005-06	32,824	5,679	17.30	1,503	4.58
2006-07	37,794	6,252	16.54	1,652	4.37
2007-08	43,209	7,183	16.62	1,900	4.40

*at current prices Source: www.mospi.gov.in (CSO, 2009)

Milk production in India is treated to be the subsidiary activity along with the agriculture unlike western countries where it is an organised activity. The rural people mostly hold one to five cattle in their sheds and produce small quantities of milk hence the procurement of the same follows a long way through bulk cooling and transportation. This practice is not applicable in the western countries since milk is produced in a bulk manner and sent directly for processing bypassing lot of intermediate stages. The collection of milk from geographically scattered milk collection centres brings a formidable challenge in maintaining the quality and low cost (ICAR, 2002).

Keeping aside all problems, Indian dairy industry has made a magnificent progress both in milk production as well as per capita consumption over a period of last 17 years. From a mere 55.7 million tonnes in 1991-92 it has reached up to the level of 108.5 million tonnes in 2008-09, depicting a Compounded Annual Growth Rate (CAGR) of 4.0 percent while per capita consumption of milk increased from 178 gms per day in 1991-92 to 258 gms per day in 2008-09 depicting a CAGR of 2.2 percent (Ministry of Agriculture, GOI, 2009). Today milk is presumed to be the largest crop surpassing rice and wheat in terms of its output value (Ghanekar, 2008). The estimated size of the Indian dairy sector at consumer prices is figured to be Rs.2,273 billions where one third of the contribution comes from the liquid milk only (Dairy India, 2007). Average annual growth rate of milk from 2000 to 2007 has been found to be 3.01 percent in India (Khanna, 2008).

The credit of being the largest producer of dairy and allied products in the world is attributed to the "Operation Flood" which was a rural development programme initiated by National Dairy Development Board (NDDB) in the year 1970. The objective of the endeavour was to create a nationwide milk grid. This was a huge success began with the Anand Milk Union Limited (AMUL, Gujarat). Dr. Varghese Kurien, considered as the architect of India's "White Revolution" gave the management skills and necessary thrust to the cooperatives. Presently the industry is strengthened with 22 state milk federations, 177 milk unions, 110,000 cooperative societies and more than 12 million milk producers.

Around 45 percent of the milk produced in the country still remains with the producers due to the higher transaction cost (Banerjee, 2008). More than two third of the total milk produced is consumed in the liquid form and the rest is utilised for making other allied products. It is has been found that, 800 out of 3,700 cities and towns along with some rural areas are networked with branded and pasteurised milk, which represents only 15 per cent of the organised milk market. The existence of the rest 85 percent unorganised market can be captured for proper channelisation implicating tremendous scope for the industry to expand (Nataraj, 2005). This growth is going to come from the greater emphasis on the processed foods sector and also by increase in the conversion of milk into milk products. The industry is highly specialised encompassing procurement, storage, processing, production and distribution of dairy and its derivatives.

1.2.1 Milk production and per capita availability in India

The 15 states contribute on an average 90 percent of the total milk produced in the country. The same is reciprocated in case of milk procurement and marketing (90 percent) by the respective dairy federations of these states. It is seen that more than half (55 percent) of the milk produced comes from the buffaloes where Haryana is on the top (85 percent). Apart from Karnataka, Orissa, Tamil Nadu, WB and Kerala, other states' milk production is buffalo based and hence India's production is more of buffalo based. India's milk production is rising continuously over last few years has made India the global leader in milk production. The milk production has increased from 21.2 million tonnes in 1968-69 to 108.4 million tonnes in 2007-08 and is expected to grow again. Similarly the per capita availability of milk has increased from 233 gms per day in 2004-05 to 258 gms per day in 2008-09.

Table 1.5: State-wise milk production and per capita availability

States	Milk production ('000 tonnes)					Per capita availability (gms/day)				
	04-05	05-06	06-07	07-08	08-09	04-05	05-06	06-07	07-08	08-09
AP	7,257	7,624	7,939	8,925	9,570	250	260	269	299	317
Bihar	4,743	5,060	5,450	5,783	5,934	147	154	163	170	172
Gujarat	6,745	6,960	7,533	7,911	8,386	344	349	374	387	403
Haryana	5,222	5,299	5,367	5,442	5,745	631	628	633	632	645
HP	870	869	872	874	884	378	373	370	367	365
Karnataka	3,917	4,022	4,124	4,244	4,538	194	197	200	204	215
Kerala	2,025	2,063	2,119	2,253	2,441	169	171	172	181	197
MP	5,506	6,283	6,375	6,572	6,855	233	262	259	262	271
Maharashtra	6,567	6,769	6,978	7,210	7,455	176	178	182	186	188
Orissa	1,283	1,342	1,431	1,625	1,672	92	95	100	112	115
Punjab	8,554	8,909	9,168	9,282	9,387	917	943	961	962	957
Rajasthan	8,310	8,713	9,375	9,536	9,491	376	387	408	408	399
Tamil Nadu	4,784	5,474	5,560	5,586	5,673	204	231	232	231	234
UP	16,512	17,356	18,095	18,861	19,537	254	262	267	273	279
WB	3,790	3,891	3,982	4,087	4,176	124	126	126	128	131
All India	92,484	97,066	100,869	104,840	108,463	233	241	246	252	258

Source: http://dahd.nic.in (2009)

As far as the states are concerned some of them are doing extremely in milk production and processing. The forerunners here are Uttar Pradesh (UP), Andhra Pradesh (AP), Rajasthan, Punjab and Gujarat who on an average have produced 11,274 thousand tonnes of milk in the year 2008-09. UP is found to be unbeatable in production which produces more than 19,000 thousand tonnes of milk per year and the trend is increasing further. In case of Punjab, Haryana, Gujarat, Rajasthan, Himachal Pradesh (HP), AP, UP and Madhya Pradesh (MP) are above the national average of per capita availability of milk. Other states are below the national average and especially the state of Orissa is at a precarious situation wherein the per capita availability of milk is only 115 gms per day and has been seen to be almost stable over last few years. Punjab's per capita availability of milk is much above the national average which is found to be 957 gms per day followed by Haryana and Gujarat. In spite of the lower level of milk production, HP comes on top five-list in this category due to its less population. Due to higher population UP's per capita availability is 279 gms per day which is slightly above the national average.

1.2.2 Consumption expenditure on milk

Milk and milk products account for a significant 17 percent of the expenditure on total household expenditure on food (Vaswani, 2008). Consumption expenditure on total food items vs. milk is depicted in the table both from rural and urban view points to make a comparison.

Table 1.6: Per capita monthly consumption expenditure on milk

Year	Rural (Rs.)				Urban (Rs.)			
	Milk products	Total food	Total expendit.	Av size of household	Milk products	Total food	Total expendit.	Av size of household
July'01 to June'02	41.91	276.35	498.27	5.02	75.82	402.31	932.79	4.48
July'02 to Dec'02	45.34	292.27	531.49	5.00	78.19	429.79	1,011.97	4.40
Jan'03 to Dec'03	44.69	299.86	555.55	5.00	80.03	429.12	1,022.68	4.50
Jan'04 to June'04	47.60	304.60	564.70	5.08	82.98	441.48	1,060.16	4.42
July'04 to June'05	47.31	307.60	558.78	5.08	83.30	447.41	1,052.36	4.55

Source: http://mospi.nic.in/nsso_test1.htm (2006-07)

The table 1.6 reveals that, the expenditure on the milk products in both rural and urban areas are increasing over years. The urban people are spending the double on this item comparing to the rural people which on an average 19 percent of total expenses on food items. Concerning to the total expenditure on both food and non-food items, the expenditure on the milk products is about 8 percent in the urban areas. Similarly the expenditure percentage of milk products over total expenditure (food and non-food) is same as in urban areas where it is 15 percent of total expenditure on food items. Even though the expenditure on milk products over total expenditure (4 percent) is remaining same in both rural and urban areas still there is a difference when it comes to total expenditure on food items. The rural per capita consumption expenditure on milk is almost half of the urban per capita consumption expenditure. This indicates the income elasticity of demand of premium products like milk and dairy products.

1.2.3 Cooperative based dairying in India

In the year 1965 the National Dairy Development Board (NDDB) was formed to help farmers against exploitation from the clutches of the middlemen. The basic objective of this is to support farmers financially by promoting the cooperative based dairy production in the country. Later on in the year 1970 it started "Operation Flood Programme" with its basic objective and continued till 1996 entangling all major states of the country. Along with the government of India funding and support it was supported by the World Bank loan to cater the needs of the cooperative based dairying in India. In addition to this basic objective it also promotes commodity-based cooperative, allied industries and veterinary biologicals to further cater to the need of the dairy industry in the country in a massive scale. According to NDDB, as on March 2009 some of its dairy network's achievements are:

- 15 major dairy federations instituted
- 177 milk unions involved
- Operates in over 346 districts of the country
- Covers 133,349 village level dairy societies
- 13.9 million farmer members out of which 3.9 million are women
- On an average 25 million litres of milk is procured per day by the federations
- Average daily cooperative milk marketing has gone up to 20 million litres with an annual growth rate of six percent compounded over the last five years
- Milk is sent to far off places (2,000 kms distant places) to cater the need of consumers by rail and road milk tankers
- Setting up of Automatic Milk Collection Unit (AMCU) and Bulk Milk Cooler (BMC) at grass root level to minimise post harvest losses

There major dairy federations in the country market 20,041 thousand litres of milk per day in the urban areas through the cooperative based dairying process (table 1.7 and table 1.7A). The dairy federations are the apex bodies in the cooperative sector of a state which procures, process, produce, market and promote milk products. It's no wonder that some of the dairy federations have made their presence throughout the country viz. Amul of

Gujarat Cooperative Milk Marketing Federation (GCMMF), Vijaya of Andhra Pradesh Dairy Development Federation (APDDCF) and Nandini of Karnataka Cooperative Milk Producers' Federation (KMF). GCMMF's Amul has not only restricted its business to the country rather it has made its global presence possible. Today it is one of the best 21 milk processors in the world processing 2.7 million tonnes of milk with a market share of 0.4 percent (IFCN, 2009).

No matter how strong or weak is the federation its basic aim is to serve the milk producers in the rural areas and consumers in the urban areas. In this way it provides training to various stakeholders and conducts several awareness, veterinary programmes in the respective state. One of the major activities of this is to promote and conduct A.I programmes in the state for the dairy producers. During 2007-08, at the national level, there are 29,724 A.I programmes conducted for the benefit of the milk producers of various societies. AP (399), Karnataka (359), Kerala (354) and Maharashtra (352) have conducted maximum number of such programmes. Some of the major functions of the cooperative based dairy system are discussed hereunder.

1.2.4 Dairy cooperative society – milk collection

As on March 2009 there are 133,349 DCSs exist throughout the country with an average DCS base of 8,890 per federation. Maharashtra and UP have got highest number of DCSs, respectively 21,492 and 20, 473. Orissa, West Bengal (WB) and Himachal Pradesh (HP) are on the lower side indicating the sub-optimal performance of the cooperative based dairying in the states. DCSs are the voluntary organisations set up by the union or federation of the concerned state to organise milk producers to facilitate them round the year milk marketing. In some cases the initiative is also taken by the villagers to set up a society in their locality to facilitate milk marketing.

As far as the procurement of these societies is concerned it is seen that Gujarat's societies are procuring the highest amount of milk for the federation (639 kgs per day). The national average in this case is merely 188 kgs per day. Andhra Pradesh (AP) and Karnataka's societies are found to be procuring 287 and 284 kgs of milk per day in two shifts viz. morning and evening. Orissa is found to be at a level of 95 kgs while the highest milk producing state Uttar Pradesh (UP) is able to procure only 35 kgs of milk per day through its dairy cooperative societies.

1.2.5 Milk producing members – contributions to societies

As per NDDB rules anybody can be a member of a cooperative society by purchasing a share of Rs.11where Re.1.00 is the entry fee and Rs.10. is preserved towards share capital. Gujarat, the only state in the country where the white revolution originated from, has got the highest number of members on the roll of the societies (2,839 thousand) followed by Tamil Nadu (2,203 thousand) and Karnataka (2,024 thousand). Tamil Nadu, Gujarat and Kerala's average farmer membership per DCS are found to be respectively 223, 208 and 208 nos where the national average is merely 104 nos. The highest milk producer in the country, UP is seen to be lacking to organise the milk producers into the DCSs (47 nos). The average milk delivery of a farmer in Gujarat, Rajasthan and Punjab are respectively 3.07, 2.44 and 2.39 litres per day against national average of 1.81 litres.

1.2.6 Milk union - procurement

Milk union offices basically function from the district head quarters. They, through their chilling centres/bulk milk coolers send milk to the dairy plant for further processing. UP and MP are having highest milk unions respectively to 30 and 23 nos. While making a comparison of the DCSs per union it is found that Bihar, Kerala and Gujarat have respectively 1,464, 1,194 and 1,137 societies under each union. Here the national average is 753 where MP and WB are found to be backward. It has been seen that the average milk procurement by a union in India is 142 thousand kilogram per day (TKgPD) while Gujarat has an outstanding performance in this case making it to the level of 727 TKgPD with a total procurement of 8,726 TKgPD. Orissa and UP's unions are able to procure merely 30 and 24 TKgPD of milk for the corresponding dairy plants in the states.

1.2.7 Dairy plants – processing and marketing

It is seen that, of the total dairies in the country more than one third are cooperative or government based and the rest are owned by the private parties. But these category dairies have capacity of handling more than half of the total procurement in the organised sector. UP, Haryana, Punjab and WB milk markets are dominated by the private dairies whereas Orissa, Kerala, Gujarat, Rajasthan and Maharashtra milk markets are dominated by the cooperative or government dairies (Ministry of Agriculture, GOI, 2006). There are 173 dairy plants in the country with total processing capacity of 26,954 TLPD where each plant on an average is supplied milk from one union.

Table 1.7: Comparative statistics of dairy federations in India

States	Name of the Federations	DCS Organised (nos)	Farmer Members ('000 nos)	Women Members ('000 nos)	Cooperative Unions (nos)	Dairy Plants (nos)	Processing Capacity (TLPD)	Milk Procurement (TKgPD)	Milk Marketing (TLPD)	A.I Programmes ('000 nos)*
Andhra Pradesh	APDDCF	4,656	825	167	9	12	2,437	1,337	1,395	3,595
Bihar	COMPFED	7,320	373	57	5	10	780	413	395	251
Gujarat	GCMMF	13,646	2,839	784	12	19	6,595	8,726	2,931	745
Haryana	HDDCF	6,668	309	73	6	5	470	534	332	1,845
Himachal Pradesh	HPSCMPF	739	32	11	3	3	30	46	19	572
Karnataka	KMF	11,432	2,024	638	13	15	2,130	3,248	2,267	4,673
Kerala	KCMMF	3,582	745	159	3	9	900	758	979	1,062
Madhya Pradesh	MPCDF	5,615	265	46	23	29	3,820	526	408	748
Maharashtra	MRSDMM	21,492	1,761	430	5	5	1,030	3,292	2,892	1,762
Orissa	OMFED	3,111	175	74	5	5	135	296	274	894
Punjab	MILKFED	6,711	387	53	11	9	1,550	925	656	2,983
Rajasthan	RCDF	13,681	678	199	16	15	1,425	1,655	1,191	1,491
Tamil Nadu	TCMPF	9,900	2,203	863	12	15	2,700	2,246	1,986	3,479
Uttar Pradesh	PCDF	20,473	966	264	30	16	1,680	713	455	2,617
West Bengal	WBCMPF	2,787	203	68	14	6	1,272	232	663	1,937
India	-	133,349	13,893	3,916	177	173	26,954	25,089	20,041	29,724

Table: Table 1.7A: Operational summary of dairy federations in India

States	Members/ DCS (nos)	Members/DCS (Women nos)	Women Participati. (%)	Procurement/ DCS (kgs)	A.I Programme/ DCS (nos)	Delivery/ Member (kgs)	Procurement/ Union (kgs)	Milk Marketing /Plant (lts)	Marketing/ Procureme. (%)
Andhra Pradesh	177	36	20.24	287	772	1.62	148,556	116,250	104.34
Bihar	51	8	15.28	56	34	1.11	82,600	39,500	95.64
Gujarat	208	57	27.62	639	55	3.07	727,167	154,263	33.59
Haryana	46	11	23.62	80	277	1.73	89,000	66,400	62.17
Himachal Pradesh	43	15	34.38	62	774	1.44	15,333	6,333	41.30
Karnataka	177	56	31.52	284	409	1.60	249,846	151,133	69.80
Kerala	208	44	21.34	212	296	1.02	252,667	108,778	129.16
Madhya Pradesh	47	8	17.36	94	133	1.98	22,870	14,069	77.57
Maharashtra	82	20	24.42	153	82	1.87	658,400	578,400	87.85
Orissa	56	24	42.29	95	287	1.69	29,600	27,400	92.57
Punjab	58	8	13.70	138	444	2.39	84,091	72,889	70.92
Rajasthan	50	15	29.35	121	109	2.44	103,438	79,400	71.96
Tamil Nadu	223	87	39.17	227	351	1.02	187,167	132,400	88.42
Uttar Pradesh	47	13	27.33	35	128	0.74	23,767	28,438	63.81
West Bengal	73	24	33.50	83	695	1.14	16,571	110,500	285.78
India	104	29	28.19	188	223	1.81	141,746	115,844	79.88

Source: Data compiled from www.nddb.org, http://dahd.nic.in, www.india.gov.in, www.indiastat.com (2009), *2007-08

Madhya Pradesh and Gujarat have set up highest number of dairy plants respectively 29 and 19 numbers with processing capacity of 6,595 and 3,820 TLPD followed by UP with 16 plants with processing capacity of 1,680 TLPD. Moreover average processing capacity of a dairy plant in India is 156 TLPD whereas in Gujarat it is 347 TLPD – much above than the national average. The dairy federations of Gujarat and Maharashtra are marketing the highest amount of milk and equivalent in the states with corresponding figures for this are 2,931 and 2,892 TLPD. In aggregate, the dairies process around 10 percent of the total milk production in the country while the processing capacity of the plants is slightly more than the procurement. Orissa's dairy federation is able to market only 274 TLPD which is far below than the national average of 1,336 TLPD. Furthermore while a dairy markets more than 154 TLPD of milk in Gujarat, it is merely 27 TLPD in the state of Orissa.

1.3 Problem Definition

Being the largest producer of milk in the world India has not made a substantial progress in the field of dairy processing and trade. New Zealand which produces one fifth of India's milk production contributes almost one third to the world dairy trade. Except Amul no other brands have made any substantial progress in the field of trade and commerce in India. The reason behind this is the lack of procurement of milk and use of higher proportion (more than one third) of it towards pasteurisation and packaging.

Lack of procurement on the contrary could be attributed to low milching capacity of the Indian cows and failure in organising the milk producers in the rural areas through cooperative societies or collection centres. Only 15 percent of the producers are so far participating in the organised sector whereas the rest are not interested in the system. They may be either selling their produce in the nearby markets themselves or else happy with the middlemen process still. However the cooperative societies have somewhat failed in organising them due to various reasons even after 40 years of launch of Operation Flood Programme (OFP).

Milk producers are the arch sources of supply of milk to the industry. The growth of the industry can't be even thought up without their up gradation. Maximum of the milk producers have a very marginal land holdings with just 1 to 5 cattle on an average (ICAR, 2002). The foremost challenging problem they are facing today is the soaring prices of feed and fodder (FAO, 2010). It has been observed that, there is a sharp price rise in the year 2007 alone in case of fodder items globally which accounts for 60-70 per cent of the total cost of milk production. Because of the low milching capacity of the Indian cattle the soaring fodder prices have been a burden on the milk producer. The problem is further added with the non-remunerative milk price which gets responsible for high rate of member attrition at the cooperative societies (Thirunavukkarasu & Sudeepkumar, 2006).

Repercussions of the same are felt by the subsequent stakeholders of the supply chain (downstream) and compel them to function at a sub-optimal level leading to underutilisation of machineries and manpower. Seasonal variations, improper road connectivity and lack of infrastructural facilities at the downstream supply chain also found to hinder the operations. Outdated technologies, shortage of skilled man power, steep competition and increased cost of processing/production/distribution etc. are some of the major issues being experienced by the processing plants.

At the transporter level the increasing fuel prices is found to be a major concern for distribution related issues. Untimely delivery, delivering damaged products and increasing the price of the products, opening up of company-owned parlours under the operational area of the retail outlets put the retailers at stake in their daily business activities. Customers who are the epicentre of the whole supply chain are experiencing the product-quality deterioration which sometimes raising the issue of price-quality mismatch and leading to customer dissatisfaction.

Keeping view to the aforesaid problems a high degree of coordinated approach is essential. In context of this, the supply chain, which maximises the overall value generated in the system, is being discussed.

1.4 Supply Chain as a Solution to Existing Problems

The increasing costs are compelling the organisations to increase either the prices of products or to negotiate with the suppliers to lower down their commodity/material prices. In both the cases, two end points of the supply chain get hampered which might lead to lesser procurement at the upstream or lower market share at the downstream. Hence in order to optimise the cost and profit, it’s highly essential for the firm to manage each activity in the organisation both internally and externally. Internal stakeholders (like employees) are easy to manage while management of the external stakeholders is a complex process. However, in order to manage the whole operation both internally and externally, a judiciously planned approach becomes inevitable. One such approach could be adapting to the principle of supply chain management. The supply chain management enhances the overall value generated while optimising the system wide costs and profits. The supply chain entangles all the major stakeholders in the system by assessing their performance on regular basis and overall profit and incentives are shared among them. This is meant for motivating the suppliers, transporters, distributors, retailers and customer to be with the system in the long run to make it more successful.

The organisations who have managed their supply chain efficiently and effectively are experiencing remarkably higher benefits than ones who have failed to do so. In this context the survey results of Computer Sciences Corporation (www.csc.com) has been resorted. This indicates that the companies with good supply chains are able to save their costs (62 percent), improve quality (60 percent), delivery performance (54 percent) and customer services (66 percent) etc. Respectively 51 and 41 percent of the companies responded that their inventories have reduced and sales have gone up. On the contrary, the performances of the companies who fail to manage their supply chain effectively and efficiently are unable to take the advantages of it and hence incur heavy losses from various directions. Only 12 percent of them are experiencing an increased market share against good supply chain practitioners (32 percent). So, managing the supply chain effectively and efficiently helps improving the performance of the organisation.

1.5 Introduction to Supply Chain Management

To have a little understanding of the supply chain management, some of the supply chain definitions are hereunder mentioned (details in chapter II).

1.5.1 Definitions of supply chain

(i) "The supply chain is either the processes from the initial raw materials to the ultimate consumption of the finished product linking across supplier user companies or the functions within and outside a company that enable the value chain to make products and provide services to the customer (APICS, 1998)."

Source: www.apics.org

(ii) "A supply chain consists of all parties involved directly or indirectly in fulfilling a customer request. The supply chain not only includes the manufacturer and suppliers but also transporters, warehouses, retailers and customer themselves."

Source: Chopra & Meindl (2003)

The objective of the supply chain is to maximise the overall value generated in the system. The overall value refers to the difference between worth of the product or service to the customer and the effort of the supply chain made in fulfilling a customer's request. In order to get it more successful the total supply chain profits must be shared across all the stages (Chopra & Meindl, 2003). Other important objective of a supply chain is to minimise the total cost to meet fixed and given demand (Shapiro, 2001; Chopra & Meindl, 2003). This total cost may include the following cost heads:

- Raw material and other acquisition costs
- Inbound transportation cost
- Facility investment costs
- Direct and indirect manufacturing cost
- Direct and indirect distribution costs
- Inventory holding cost
- Inter-facility transportation cost
- Outbound transportation cost

1.5.2 Development stages of supply chain

Supply chain concept has come across three basic stages from its evolution - the Ford supply chain (first phase, 1910-1920), the Toyota supply chain (second phase, 1960-1970) and the Dell supply chain (third phase, 1995-2000). During first phase the Ford Motor company used to have an integrated chain where every part of the chain starting from the raw material to the finished product. The whole process was taking 81 hours with a huge inventory. Since this led to the inflexibility and inefficiency to meet the market demand, the Toyota Motor company (second phase) came up with the principle of 'Keiretsu' meant for effective sourcing and relationship among various stakeholders in the system. After the expansion of the global market the company wanted to take the suppliers along with it by maintaining long term relationships. This was virtually impossible to maintain for a long time and hence brought so many limitations for the company. This further led to the third phase of the revolution. In this phase the Dell Computers considered the long term relationship from strategic view point and continuously monitored the suppliers to make world class components. During this period the information technology was gaining its momentum which helped the company meeting the customers' demand by having an effective coordination with the suppliers (Shah, 2009).

1.6 Dairy-Food Supply Chain

The supply chain from a dairy industry perspective is discussed here. There are seven components/stakeholders in a dairy food supply chain namely, milk producers, dairy cooperative societies, bulk milk coolers, production plant, transporting agencies, retail outlets and customers (figure below).

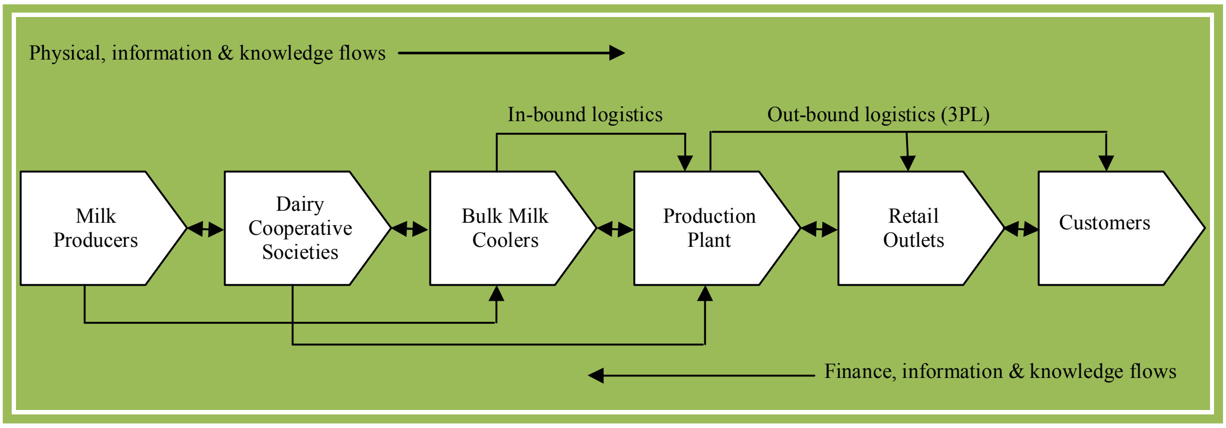


Figure 1.1: Traditional dairy food supply chain

The traditional dairy food supply chain deals with seven stakeholders. The figure 1.1 depicts that milk producers, dairy cooperative societies and bulk milk coolers are the upstream stakeholders (sometimes treated to be a component) whereas retail outlets and customers are the downstream stakeholders. The production/processing plant is at the middle and behaves as an interface between the upstream and downstream members.

The material (milk) flows through the milk runways till it reaches the production plant and gets processed there to be distributed over a specified geographical region. Since the supply chain deals with the highly perishable substance (milk and its derivatives), the marketing channel is being shortened by eliminating the distributors in the chain. This makes the supply chain more agile. There are some industrial customers, to whom the production plant directly supplies packaged milk at their doorstep. However this depends upon the dairy to design its supply chain as per requirements and feasibility conditions to handle it properly.

In the upstream direction while the material flow takes place, in the downstream the finance flow occurs in the supply chain. In the whole process, sharing of information and knowledge are two important factors which help the supply chain to perform effectively. A basic priority for the dairy industry is to ensure that products distributed to the customers are safe and suitable for consumption. Milk borne injuries can be extremely fatal leading to unnecessary litigations by tarnishing the image of the company in the long run. Since bacteria can grow in milk very rapidly and make it perished, it results in incurring heavy losses to the stakeholders in the supply chain. This nature of milk is very unique among all food items; which needs immediate attention and throughout the supply chain it requires to be transported in conditioned/insulated vehicles. In spite of this liquid milk procurement and distribution (except ultra high temperature treated milk) has not been made possible beyond a particular region due to high perishability nature of milk. An efficient and effective supply chain management operation could provide for hygienic measures throughout the supply chain by adhering to the proper food value requirements.

1.6.1 Drivers and flows of a dairy food supply chain

The drivers of the supply chain influence the performance and hence the proper management and coordination of them are essential. The major drivers of any supply chain are facilities, inventory and transportation which are responsible for the material flow in the organisation while other factors like finance, knowledge and information are required to keep the supply chain an ongoing process.

- **Facilities** are the places where the dairy products are manufactured and stored, basically the production plants and the chilling centres.
- **Inventory** constitutes raw milk procured from the milk producers through milk producers' cooperative societies, semi-finished and finished products. It exists in the supply chain because of the demand fluctuations.
- And the **inbound and outbound** logistics entangles the flow of materials to the plants and flow of items to the end users through the proper mode of transportation.
- **Finance** flows encompasses the series of financial relationships that start with the customer buying the product or service at a given price and ultimately the revenue generated out of it is allocated to the various stakeholders of the supply chain.
- On the contrary, the **knowledge** flow in the supply chain is the intellectual input into the chain that leads to the added value in the product or service.
- Today's markets are changing at an alarming speed. In order to keep track of the market places better, rapid gathering and disseminating of **information** is inevitable.

In this context, the information flow in the dairy food supply chain includes the market signalling amongst the supply chain members regarding the end user preferences.

- Product, process and service innovations are the results of the knowledge dimension. The supply chain **coordination** aims at increasing the total supply chain profits and maximising end user satisfaction. The lack of proper supply chain coordination leads to bullwhip effect. This occurs because of the conflicting objectives and individualistic attitude of the stakeholders in maximising profits.
- Supply chain **incentives and/or penalties** are used to reward/penalise good/bad performance and share risk. The reason behind incentive sharing is to motivate the stakeholders to perform better and work hard to enhance the total supply chain profitability. Since the profit/bonus/incentives are shared stakeholders feel that they are the part of the system and do not hesitate to share risks and head responsibility**.**

1.6.2 Major challenges for dairy food supply chain

Today more and more companies are entering the market with their world class products which in turn makes the customers more demand driven and diversified. This leads to stiff competition among the organisations to develop innovative products that can meet the demand of the customers with the shortest possible time. The resources are scarce and users of the resources are plenty. Had it been land, raw materials or crude oil (fuel), the costs are increasing irrespective of the nature of the business. Moreover the costs relating to the technology, skilled man power and the efficient and effective suppliers are also substantially increasing day by day. Any attempt made to improve the efficiency of the organisations is likely to be inconsequential without proper coordination.

1.7 Research Gap and Framework

After coming across the existing literature available in the dairy industry and supply chain management, it is found that supply chain management in dairy industry, entangling all the stakeholders from the milk producer level till the customer level, can be further studied to fortify the field. Moreover risk, coordination and performance etc. are upcoming areas in the field of supply chain management and their application to an industry like dairy will definitely add value to the existing literature. Though the research does not claim to have tackled all the problems in the sector (Anand pattern dairying) still it tries to focus on some difficult areas and their redressal mechanism.

The below given chart is followed for accomplishing the research. A great deal of effort has been taken to minimise common method bias (CMB) to make the research useful.

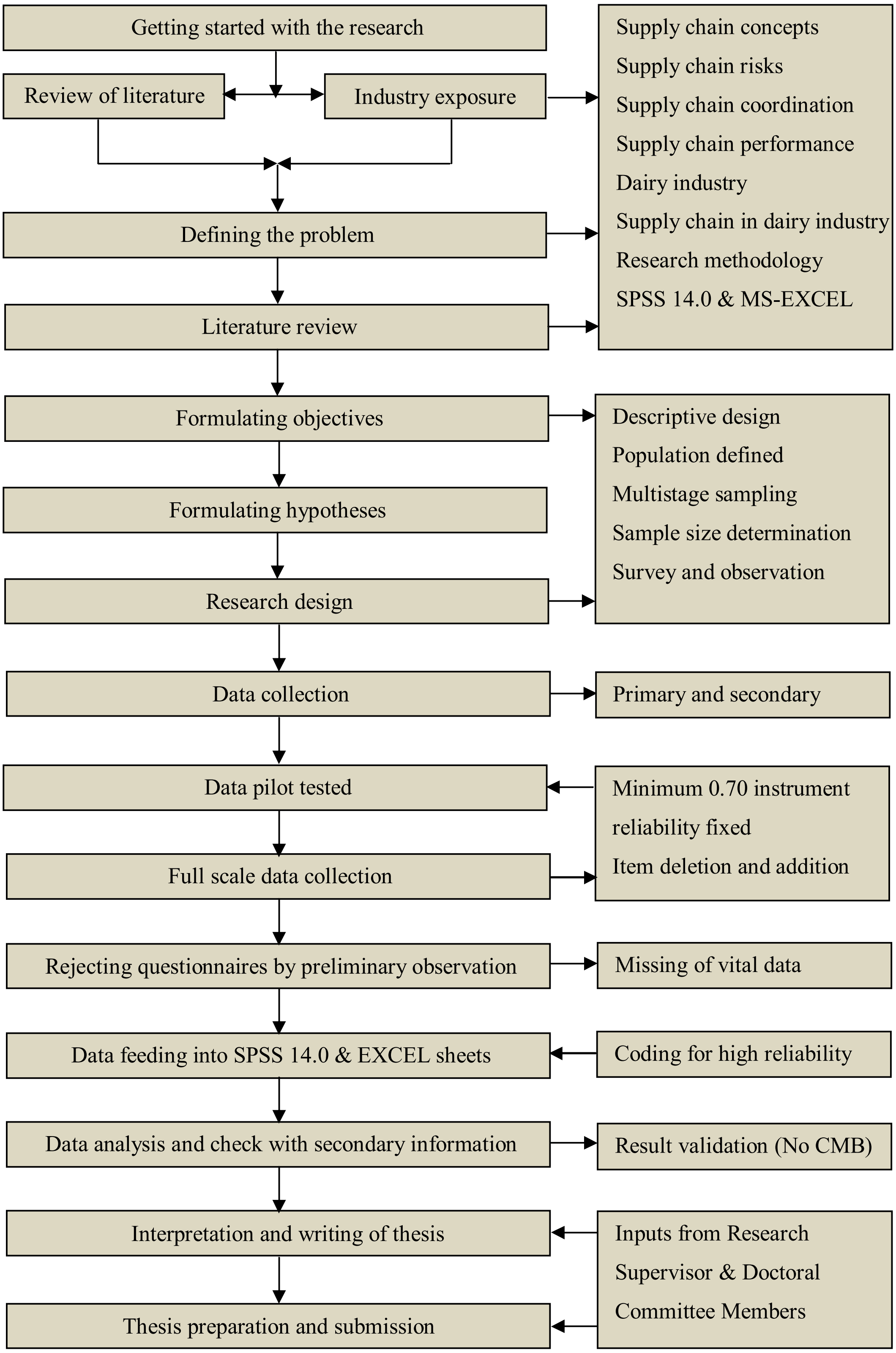


Figure 1.2: Research framework

1.7.1 Research questions

On the basis of background of the research and gaps studied the following research questions have been formulated. At the beginning it is an attempt to analyse ongoing practices from a dairy industry perspective. Supply chain risk, coordination and performance issues have been taken into consideration along with the ongoing practices to make the scope of the study broad and wide. Necessary care is taken to correlate the variables to frame the hypothesis.

(i) What is the present course of action in production, procurement, processing and distribution?

(ii) What are the risks and uncertainties and their impact on the supply chain?

(iii) What are the influencing factors for good coordination mechanism and its present status?

(iv) What are the influencing factors of supply chain performance and its present status?

(v) Do risks and uncertainties influence the supply chain performance?

1.7.2 Research objectives

Establishing the current situation within the dairy industry in terms of supply chain management practices and evaluating underlying the factors of supply chain performance. The broad objective is further divided into the following sub-objectives. They are namely;

(i) to study the on-going supply chain management practices relating to the procurement, processing, production and distribution of milk and allied products;

(ii) to identify the various risks and uncertainties at all levels which affect the smooth functioning of the dairy-food supply chain;

(iii) to evaluate the degree of supply chain coordination by identifying the underlying factors of it;

(iv) to measure the stakeholders' performance at all level to reach at overall supply chain performance including customer satisfaction and

(v) to provide a platform to overcome risks and uncertainties for maximising total supply chain profitability.

1.7.3 Research hypotheses

The below given hypotheses are framed to be tested for the study and correlate significant variables.

Table 1.8: List of research hypotheses framed

Sl. No	Hypotheses	Level
(i)	Participating in the supply chain brings down cost of milk production	Milk producer
(ii)	Participating in the supply chain lowers down risks and uncertainties	Milk producer
(iii)	Participating in the supply chain improves overall performance	Milk producer
(iv)	Higher is the membership higher is the amount of milk collection	Dairy cooperative society
(v)	The larger the pouring membership the higher is the level of collections	Dairy cooperative society
(vi)	Higher pouring capacity of producer members increases the level of collection	Dairy cooperative society
(vii)	The larger is the operational area the higher is the level of procurement	Bulk milk cooler
(viii)	The larger is the DCS base the higher is the level of procurement	Bulk milk cooler
(ix)	The higher is the milk producer participation (active members) the higher is the quantum of procurement	Bulk milk cooler
(x)	The higher is the level of procurement the lower is the cost of chilling	Bulk milk cooler
(xi)	Retailing of dairy products is a low investing and high profit making business concern	Retail outlet
(xii)	Higher is the area of operational area higher is the sales	Retail outlet
(xiii)	There is a high degree of positive correlation between income and expenditure on dairy products	Customer
(xiv)	Customers are increasingly becoming quality conscious while making a purchase	Customer
(xv)	Risk and uncertainties exist at each level of the supply chain	All
(xvi)	Endogenous risks have more chances of occurrence than exogenous ones	All
(xvii)	Higher is the trust higher is the level of commitment and better is the buyer-supplier relationship in the supply chain	All
(xviii)	The higher is the degree of supply chain coordination the lower is the risk	All
(xix)	There is a difference in the performance level of stakeholders	All
(xx)	Supply chain performance is positively influenced by the risk coping efficiency of the stakeholders	All

1.8 Data and Methodology

The dairy industry in India is mainly constituted of 22 state milk federations having more than 177 milk unions, 110,000 dairy cooperative societies involving 12 million milk producers. Britannia, Nestle, Mother Dairy and some regional private companies' existence has further cherished the industry. State milk federations are the major players in their respective states.

1.8.1 Target population

For the recent study the state of Orissa is considered purposively where 40 percent of the people fall under the below poverty line (BPL) being the highest in the country. The Indian average in this case is found to be 22 percent where Punjab has the least figure that is five percent (Planning Commission, GOI, 2004-05). Low per capita availability of milk, milk productions and marketing etc. are considered as some of the major driving forces to opt for the state as the area of field study. As far the dairy federations are concerned, dairy federations of Gujarat, Karnataka and Tamil Nadu are doing extremely well and states like Orissa, West Bengal (WB) and Himachal Pradesh (HP) are the backward performers in the cooperative based dairying sector.

The methodology broadly followed here is the case based research (Eisenhardt, 1989; Miles & Huberman, 1994; Easton, 1998; Voss, Tsikriktsis, & Frohlich, 2002; Yin, 2003) supported by survey data. Especially, in case of operations management case based methodology is widely used (Voss et al., 2002). This methodology also holds good while comparing two different organisations for their operations management practices (Easton, 1998).

1.8.2 Target population profile

The government of India started Operation Flood programme (OFP) in the year 1970 entangling Andhra Pradesh, Bihar, Gujarat, Haryana, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal and Delhi in its first phase with an initial outlay of Rs.945 millions. The basic aim of the programme was to develop milk marketing sector in the country by eradicating the role of middle men in the system. After successful implementation of the first phase, second phase of OFP was launched during the year 1979. The state of Orissa was included during the year 1980 covering four districts of it namely; Cuttack, Puri, Dhekanal and Keonjhar (map of Orissa provided below). Soon after launch of OFP in Orissa, the Orissa State Cooperative Milk Producers' Federation, in short "OMFED" (figure 1.4), started functioning from 18th January 1980 with an objective of integrating milk producers in the rural areas with consumers in the urban areas. As a result of various financial assistant from the Government of India, it has made a significant progress in milk production in the state (table 1.9).

Table 1.9: Funds released versus milk production: India vs. Orissa

Year	Funds released (Rs. millions)		Milk production ('000 tonnes)	
	India	Orissa	India	Orissa
2000-01	2,160	170 (7.9)	80,607	876 (1.1)
2001-02	1,344	8 (0.6)	84,406	929 (1.1)
2002-03	1,416	126 (8.9)	86,159	941 (1.1)
2003-04	1,647	38 (2.3)	88,082	994 (1.1)
2004-05	1,857	114 (6.1)	92,484	1,283 (1.4)
2005-06	873	113 (12.9)	97,066	1,342 (1.4)
2006-07	786	27 (3.4)	100,869	1,431 (1.4)

Note: figures in bracket are in percent Source: www.indiastat.com (2008)

Within the period of seven years, the milk production in the country is recorded with CAGR of 3.2 against 7.3 percent in the state of Orissa. At the same time the investment has decreased by almost 14 percent at national level whereas it has drastically come down by a CAGR of 23 percent at the state level. In spite of the low funding, both dairy sector of the state and OMFED are showing positive growth in milk production and procurement respectively. OMFED is procuring and marketing around one fifth of the milk produced in the state.

In addition to the milk procurement and marketing OMFED has diversified its business to horticulture and organic products. It is also manufacturing cattle feeds to provide the milk producers in the rural areas at a subsidised rate to encourage milk production and aiming to help them to earn profit. As of today there are three training centres in the state offering various programmes to the stakeholders in different capacities so as to help them to establish their presence in the system. Lot of other developments have been made in it under Operation Flood-III during 1985-96 and Integrated Dairy Development Project (IDDP) of Government of India.

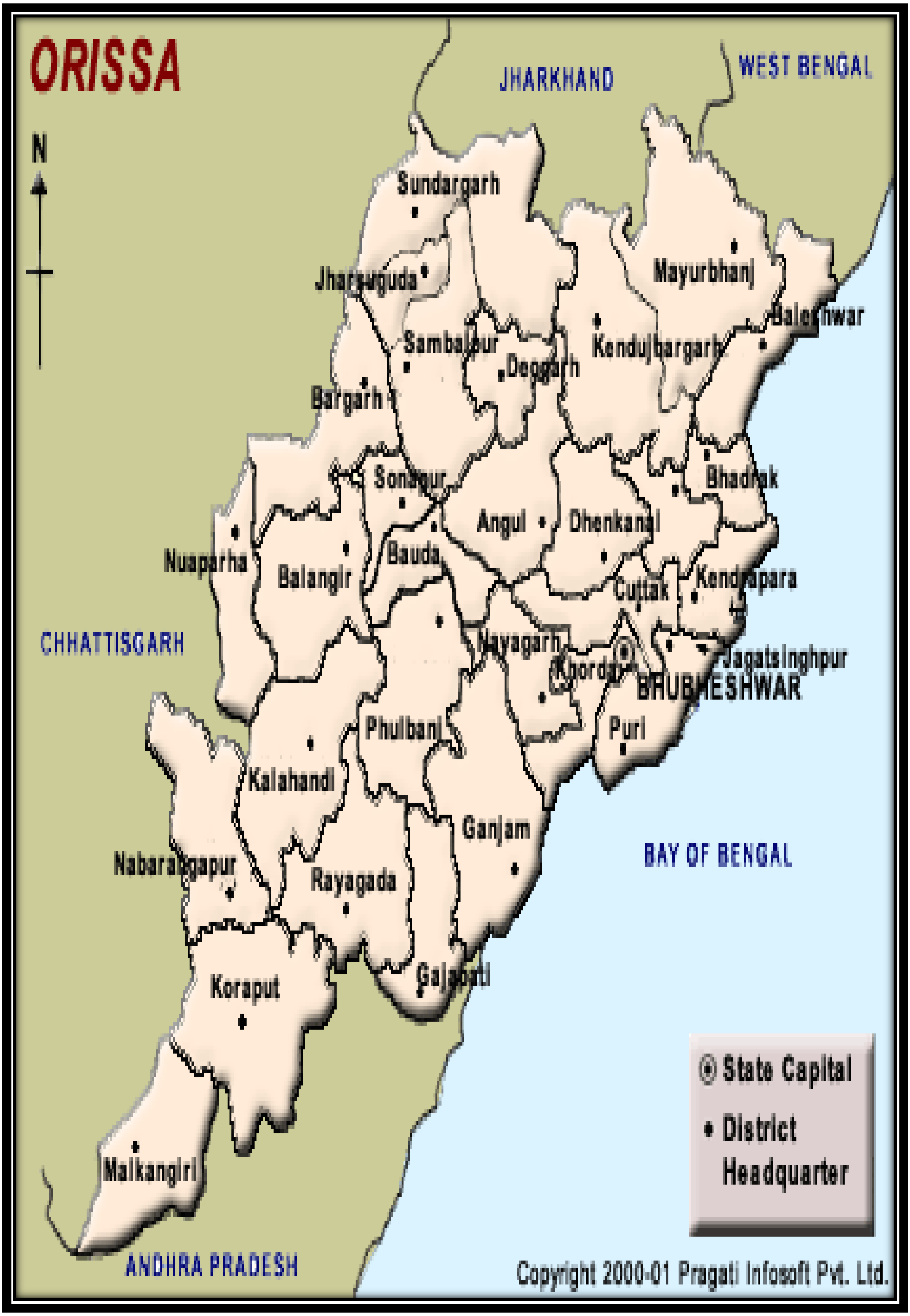


Figure 1.3: Map of Orissa

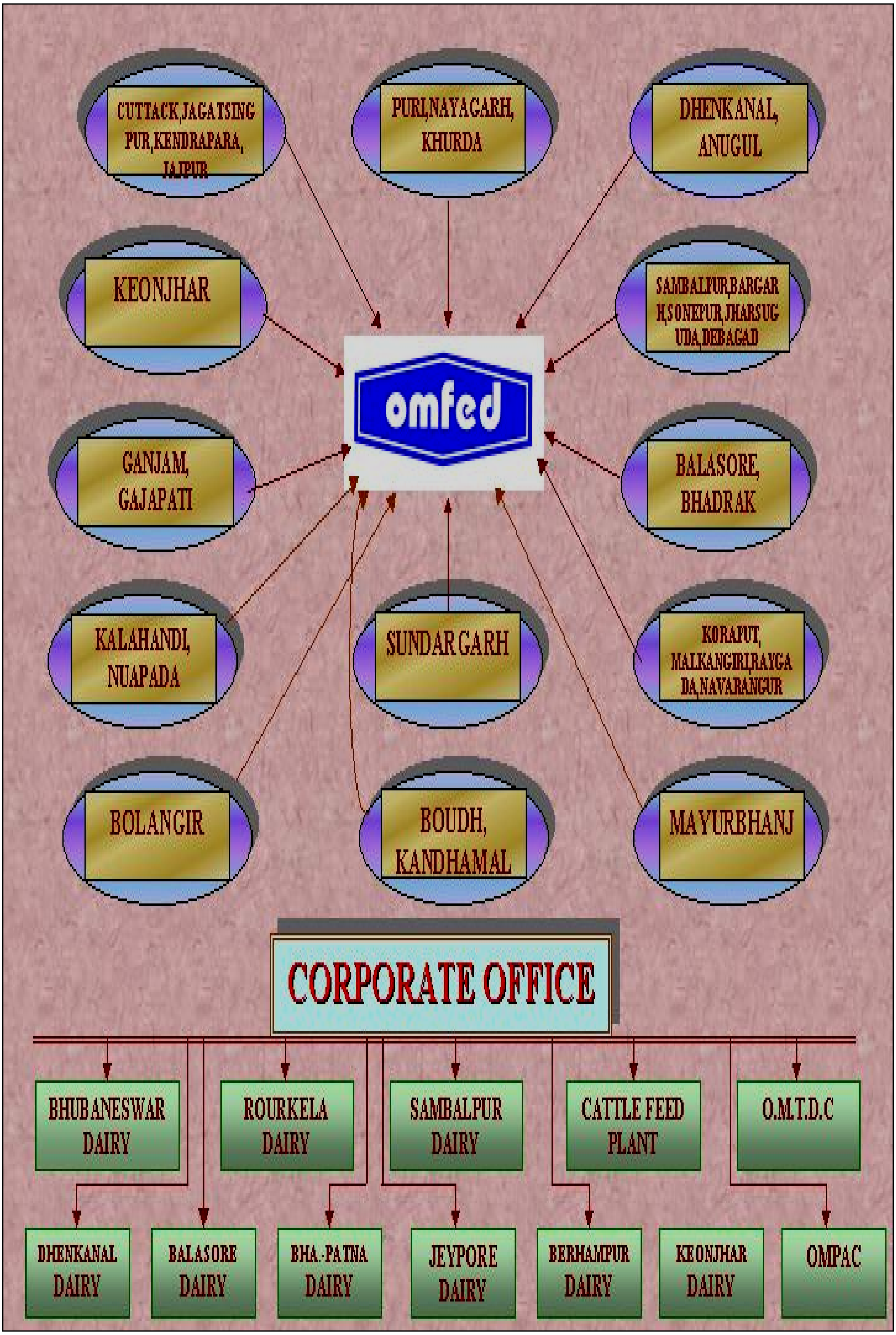


Figure 1.4: OMFED at a glance

1.8.2A: Physical and financial achievements of OMFED

The below given tables indicate the various developments of the dairy federation over a period of five years. The physical and financial achievements are mentioned hereunder:

Table 1.10: Physical achievements-I of OMFED

Dairy plants	Processing capacity	Milk unions	Bulk milk coolers	Dairy coop. societies	Milk producers	Retailers
Dhenkanal	10,000	1	4	206	13,802	136
Jaipur	10,000	1	26	354	15,964	88
Keonjhar	10,000	1	9	188	8,992	111
Bhawanipatna	20,000	1	21	262	9,543	107
Berhampur	28,000	2	21	312	12,100	465
Rourkela	30,000	1	1	62	6,250	235
Balasore	50,000	2	48	524	27,260	274
Sambalpur	50,000	1	37	427	28,027	268
Bhubaneswar	2,25,000	2	100	2,290	124,472	1,176
Total	4,33,000	12	267	4,625	246,410	2,860

Source: Management Information System, OMFED (as on March 2009)

Table 1.11: Physical achievements-II of OMFED

Particulars	Unit	2004-05	2005-06	2006-07	2007-08	2008-09
Organised societies	Nos	2,604	3,377	3,822	4,387	4,625
Farmer members	Nos	167,802	204,013	224,002	236,199	246,410
Milk procurement	Lt/day	188,500	352,000	354,368	360,256	361,402
Milk sale	Lt/day	174,219	318,213	354,368	361,439	363,580
SFM sale	Bottles	1,418,433	161,766	1,476,438	1,579,778	1,635,986
BMS sale	Packets	1,947,390	4,176,558	3,364,684	4,545,185	5,947,118
Lassi sale	Packets	713,214	1,382,556	1,503,606	1,886,983	2,478,910
Plain curd sale	MT	1,387	2,266	2,374	2,871	3,802
Sweet curd sale	MT	334	547	597	752	739
Paneer sale	MT	294	352	231	332	546
Ghee sale	MT	328	414	368	395	390
Butter sale	MT	86	10	7	11	12
Chhenapoda sale	MT	41	33	16	17	39

Source: www.omfed.com (2009)

It can be seen from the tables 1.10 and 1.11, there has been an increasing trend in society formulation, farmer involvement and milk procurement during the mentioned years. Since

2004-05 to 2008-09 the capacity has been found to be doubled up but seem to have a lesser performance in case of procurement of milk. It is calculated that, on an average a society in the village is constituted of 50 milk producers, pouring just 78 litres of milk per day. The average pouring capacity of a typical milk producer is found to be around 1.5 litres per day which is less than half of a milk producer's contribution in the state of Gujarat. Though during 2008-09, there is a significant growth achieved in case of society formulation (12 percent) and organising milk producers into societies (5 percent) over the preceding year, the progress in procurement is found to be only 1.6 percent.

Table 1.12: Financial achievements of OMFED (Rs. millions)

Particulars	2004-05	2005-06	2006-07	2007-08 (P)	2008-09 (P)
Share capital	45	47	47	47	50
Sales turnover	1,099	1,495	1,706	2,139	2,695
Gross profit	103	115	115	146	257
Profit after tax	10	10	3	24	28

Source: www.omfed.com (2009), *P - Provisional

Almost the same growth has been achieved in case of sales during last five years. Some of the product sales have gone manifold whereas some are recently launched and found to getting good response from the customers. During the last five years the share capital of the federation seems to be stagnant whereas there has been a constant rise in the sales turnover and gross profit there to. It can be seen from the table 1.12 that, both sales and the gross profit have gone up with a CAGR of 20 percent each. This shows the tremendous potential of the federation to grow further even if the profit after tax is not spectacular (11 percent).

1.8.2B: Training programmes

Various training programmes are being conducted at three training centres of OMFED across the state. There are four different training centres available in the state at Cuttack (Jagannathpur), Puri (Nadhana), Sambalpur (Gosala) and Bhadrak. These institutions are providing training to different stakeholders at various capacities to equip them to fit into the system. As March 2009, around 20,000 beneficiaries have been trained in different capacities to cater the need of the dairy sector of OMFED. Among the various training programmes Artificial Insemination (AI), fodder management, society management, clean milk production, society supervision, air conditioning and refrigeration etc. are the major ones.

1.8.3 Working population

Out of the 10 dairies of the state one dairy has been selected at random (Balasore dairy). The dairy which is operating over a vast geographical region of around 16,000 sq kms is one of the major constituent dairies of the federation. The processing capacity of the dairy is 50,000 litres per day (LPD) is proposed to hike its capacity by another 50,000 LPD keeping view to the demand of its products among the consumers. The dairy is enriched with 27,260 milk producers, 524 dairy cooperative societies, 48 bulk milk coolers, 287 retail outlets and more than one million customers spread over the geographical regions of three districts namely Balasore, Bhadrak and Mayurbhanj. The dairy is also marketing its products on the adjoining areas of the neighbouring state West Bengal (WB).

1.8.4 Sample size and sampling technique

The proposed sample size for the research is based upon the formula suggested by Krejcie and Morgan (1970).

$$\mathbf{s} = \frac{\boldsymbol{\chi}^2\mathbf{NP}\,(\mathbf{1}-\mathbf{P})}{\mathbf{d}^2(\mathbf{N}-\mathbf{1})+\boldsymbol{\chi}^2\mathbf{P}\,(\mathbf{1}-\mathbf{P})}$$

Where, s = required sample size; χ^2 = the table value of chi-square for one degree of freedom at the desired confidence level (3.84); N = the population size; P = the population proportion (assumed to be 0.50 since this would provide the maximum sample size); and d = the degree of accuracy expressed as a proportion (0.05).

Table 1.13: Proposed vs. actual sample of research (figures are in numbers)

Sample	Milk Producer (MP)	Dairy Coop. Soc. (DCS)	Bulk Milk Cooler (BMC)	Production Plant Official (PP)	Transport Agency Staff (TA)	Retail Outlet (RO)	Customer (CUS)	Total Size (N)
Proposed sample	382	191	36	20	20	172	382	1,203
Actual sample	348	168	33	20	20	150	324	1,063
Non-response (percent)	8.9	12.0	8.3	0.0	0.0	12.8	15.2	11.6

The non-response rate mentioned in the table 1.13 is found to be insignificant by Wilcoxon and Sign tests at five percent level. Altogether there are 1,063 sample respondents have been considered including the plant manager of the dairy and the managers of two transportation companies. From the procurement chain BMC, DCS and the MP are considered in the proportion of 1:5:10 as is depicted in the table above. Similarly from the distribution chain RO and the CUS are approximately in the ratio 1:2 excluding the production plant and transportation companies. As far as the geographical locations are concerned all the operational areas of the dairy have been fully exploited to make the study broad and enlightening.

1.8.4A: Sampling and data collection methods

The production plant has been chosen at random wherein all the transporters have been considered. From the production plant, 20 sample respondents from procurement, production and marketing departments have been chosen purposively including the Plant Manager. The same sample size has been considered from the two transport agencies wherein the sample respondents are the managers and the drivers of the vehicles deputed for transportation. The sampling methods, the data collection techniques and reliability of research instruments for various sample respondents have been described in the table below:

Table 1.13A: Sampling and data collection methods (First category respondents)

Particulars vs. Components	Milk Producer (MP)	Dairy Coop. Societies (DCS)	Bulk Milk Cooler (BMC)	Retail Outlet (RO)	Customer (CUS)
Sample respondents	Milk producers	Secretaries/ Supervisor	Plants-in-Charge Operators	Retailers	Customers/ Consumers
Sampling method	Systematic	Simple random	Simple random	Simple random	Simple random
Data collection method	Survey & observation	Survey & observation	Survey & observation	Survey & observation	Survey
Research instrument	Structured questionnaire	Structured questionnaire	Structured questionnaire	Structured questionnaire	Structured questionnaire
Instrument reliability	0.70	0.76	0.80	0.70	0.79

Second category respondents: The second category respondents are the production plant officials and the transport agency staff who are chosen purposively to respond to a particular issue. In this case 40 respondents (20 each from production plant officials and transport agency staff) are interviewed through a semi-structured questionnaire. Keeping view to the less number of respondents and semi-structured questionnaire, the reliability is not tested for second category respondents.

Modus operandi: During the pilot testing it has been detected that some of the items are not being responded properly due to low understanding of business activities by the stakeholders hence observation/action research technique is resorted to avoid non-response bias. Separate questionnaires for each component have been adopted in the process. Complementary questions are asked over phone and email so as to fructify the data collected and get the doubts resolved. In-depth personal interviews have been carried out with the Managing Director, General Managers of procurement/marketing/finance, Marketing Managers of the federation/plant, Plant Manager and other officials depending upon the nature of query, they being the reliable sources of information (Philips, 1981). Without much interaction on demographic profile of federation/plant officials and transport agency staff, they are mostly queried for the risk, cooperation & coordination and supply chain operation/performance issues.

Milk producers turned up at the cooperatives (systematic sampling), secretaries/supervisors of the cooperative societies (simple random), plants-in-charge of the bulk milk coolers (simple random), retailers (simple random) and the customers (simple random) on behalf of the households at the retail outlets have been interviewed. For other stakeholders purposive sampling method has been followed to trace them and asking their opinion about certain issues. Secondary data are collected from the corporate office of the dairy federation based at Bhubaneswar, respective dairy plant and from the milk union offices at the district level.

As far as the instrument reliability is concerned the Cronbach value of 0.70 is well accepted and can be taken as a lower bound for the survey research (Nunnally, 1978; Malhotra et al., 1998; Hair et al., 1998). Even in some cases Cronbach value of 0.50 is considered to be reliable and valid (Carmines, 1979; McDougall, 1990). In the current research a reliability scores for various stakeholders has been mentioned in the table above. Since semi-structured questionnaires are adopted for the production plant and transport agencies, reliability for those instruments is not evaluated. The basic operational issues are collected through the secondary information available at their concerned offices.

Time frame: The primary data collection has been accomplished during July 2009 to April 2010 and the secondary data have been mostly collected up to March 2009 according to the availability.

1.8.4B: Geographical distribution of sample

The components in the procurement and production side of the dairy food supply chain are bulk milk coolers, dairy cooperative societies and milk producers (1:5:10 proportions). Similarly in the distribution side, the components are retail outlets and customers (1:2 ratios). The sample of each of the above categories has been taken at different proportions with respect to the variability of the population and distributed tehsil-wise as described in the table below. Figures in the parenthesis henceforth are indicating percentages unless otherwise stated. There are 21 tehsils considered in the study from three major districts of the state.

Table 1.13B: Tehsil-wise distribution of first category respondents (figures are in numbers)

Tehsil	Milk Producers	Dairy Coop. Societies	Bulk Milk Coolers	Retail Outlets	Customers	Total
Balasore	4 (1.1)	2 (1.2)	-	21 (14.0)	40 (12.3)	67 (7.0)
Baliapal	20 (5.7)	14 (8.3)	3 (9.1)	2 (1.3)	6 (1.9)	45 (4.0)
Barasahi	-	-	-	2 (1.3)	4 (1.2)	6 (1.0)
Baripada	-	-	-	19 (12.7)	35 (10.8)	54 (5.0)
Basta	9 (2.6)	12 (7.1)	2 (6.1)	2 (1.3)	4 (1.2)	29 (3.0)
Basudevpur	65 (18.7)	29 (17.3)	7 (21.2)	2 (1.3)	4 (1.2)	107 (10.0)
Betnoti	10 (2.9)	4 (2.4)	2 (6.1)	2 (1.3)	4 (1.2)	22 (2.0)
Bhadrak	16 (4.6)	7 (4.2)	2 (6.1)	22 (14.7)	73 (22.5)	120 (12.0)
Bhandaripokhari	-	-	-	2 (1.3)	6 (1.9)	8 (1.0)
Bont	16 (4.6)	7 (4.2)	1 (3.0)	4 (2.7)	4 (1.2)	32 (3.0)
Chandabali	40 (11.5)	19 (11.3)	2 (6.1)	2 (1.3)	6 (1.9)	69 (7.0)
Dhamnagar	33 (9.5)	15 (8.9)	1 (3.0)	4 (2.7)	10 (3.1)	63 (6.0)
Jaleswar	11 (3.2)	5 (3.0)	2 (6.1)	11 (7.3)	33 (10.2)	62 (6.0)
Jamsola	-	-	-	9 (6.0)	20 (6.2)	29 (3.0)
Nilgiri	2 (0.6)	1 (6.0)	-	7 (4.7)	14 (4.3)	24 (2.0)
Rairangpur	-	2 (1.2)	1 (3.0)	2 (1.3)	4 (1.2)	9 (1.0)
Rasagobindpur	4 (1.1)	-	-	2 (1.3)	4 (1.2)	10 (1.0)
Simulia	16 (4.6)	7 (4.2)	1 (3.0)	2 (1.3)	4 (1.2)	30 (3.0)
Soro	62 (17.8)	27 (16.1)	6 (18.2)	20 (13.3)	39 (12.0)	154 (15.0)
Tihidi	36 (10.3)	15 (8.9)	2 (6.1)	2 (1.3)	4 (1.2)	59 (6.0)
Udala	4 (1.1)	2 (1.2)	1 (3.0)	11 (7.3)	6 (1.9)	24 (2.0)
Total	348 (100.0)	168 (100.0)	33 (100.0)	150 (100.0)	324 (100.0)	1,023 (100.0)

Table 1.13C: Distribution of second category respondents

Second category respondents	Frequency
Director/General (Dy. General Managers)	5 (12.5)
Production/Transport Managers	10 (25.0)
Marketing/Accounts executives	8 (20.0)
Supervisors/Chemist	5 (12.5)
Third Party Logistics/Drivers	12 (30.0)
Total	40 (100.0)

The second category respondents constitute another a sample size of 40 and in total 1,063 are contacted to gather the necessary data/information for the research.

1.8.5 Demographic profile of sample respondents

Demographic profile of the all the respective stakeholders have been mentioned hereafter starting from the milk producers to the customers.

1.8.5A: Demographic profile of milk producers

It is found that 59 per cent of women are the dairy producers comparing to 41 per cent of their male counter parts (table 1.14). The dairy producers irrespective of gender are mostly in the age group of 20 to 60 and have gone mostly up to the level of high school for having their education. It is seen almost 90 per cent of the dairy producers who rear cattle in the villages are illiterates and half literates. The poor literacy level is one of the biggest issues in the case of milk production which is found to be common in case of a dairy producer. The dairy producers who basically hail from an agricultural labour or cultivator community constitute two third of the population in the villages.

Agriculture/cultivation together with dairying is found to be the most sought after profession in the rural areas (more than 80 percent). It may be noted here that the rest of the population in the villages are from other professions, who rear cattle for their extra income and consumption of the produce in the family. This kind of people does not have a substantial contribution to the milk collection at the society level.

As long as their secondary or the subsidiary professions are concerned, it is the “dairy farming” which makes it up to the level of 88 per cent approximately.

Table 1.14: Demographic profile of milk producers

Demographics	Categories	Frequency	Demographics	Categories	Frequency
Gender	Male	143 (41.1)	Landholding (acres)	Less than 1.0 (marginal)	164 (47.1)
	Female	205 (58.9)		1.0 to 2.0 (small)	130 (37.4)
Age (years)	Less than 20	7 (2.0)		2.0 to 4.0 (medium)	39 (11.2)
	20 to 40	193 (55.5)		4 .0 to 10 (large)	10 (2.9)
	40 to 60	146 (42.0)		Greater than 10.0	5 (1.4)
	More than 60	2 (0.6)	Annual income (Rs.)	Less than 25,000	175 (50.3)
Education	Illiterate	6 (1.7)		25,000 to 50,000	125 (35.9)
	Read and write	44 (12.6)		50,000 to 75,000	30 (8.6)
	Primary	123 (35.5)		75,000 to 100,000	12 (3.4)
	High School	142 (40.8)		More than 100,000	6 (1.7)
	College	33 (9.5)	Cattle size (nos)	One to two	159 (45.7)
Occupation (Main)	Agri. labour	183 (52.6)		Three to four	125 (35.9)
	Cultivation	57 (16.4)		Five to six	50 (14.4)
	Dairying	47 (13.5)		More than seven	14 (4.0)
	Business	45 (12.9)	Distance of DCS From house (kms)	Less than 0.5	157(45.1)
	Service	16 (4.6)		0.5 to 1.0	80 (23.0)
Occupation (Subsidiary)	Agrl. labour	38 (10.9)		1.0 to 2.0	80 (23.9)
	Cultivation	3 (0.9)		More than 2.0	28 (8.0)
	Dairying	301 (86.5)	Mode of conveyance to society	Walking	190 (54.6)
	Business	1 (0.3)		Cycle	155 (44.5)
				Others	3 (0.9)

Land holding is another crucial factor for the dairy producers in the villages. The dairy producers produce the green fodder and straw for their cattle to minimise the burden of expensive dry fodders available in the market place. It is found that the cost of dry fodder is increasing by leaps and bounds making a great problem for the entire dairy producing community throughout the globe. It is found that 84 per cent of the dairy producers in the villages hold only a marginal (less than one acre) and small (one to two acres) of land which put extra burden on them further. Around 47 per cent of the village dairy producers either do not possess or possess a very small landholding (marginal land holders). Only 16 per cent of the dairy producers have been found to have more than two acres of land, who are comparatively in a better position to feed their cattle. This enables them to reduce the cost of dry fodder substantially and help making profit out of this profession.

Most of the dairy producers claim that the profession can only be profitable if there could be a continuous supply of subsidised feed and fodder from the dairy federations or the organisations which procures milk from them. But, in most cases it is not possible to provide the quality feed and fodder at a subsidised rate, which equally put the organisation at stake by bringing down its profit. Clearly a lack of landholding indirectly relates to improper feeding and decrease the milk production and ultimately affects the profit and income. Lack of landholding and profit finally brings down the annual income of the dairy producers. It is found that 86 per cent of the dairy producers have got their annual income below Rs.50, 000 and the rest 14 per cent earn more than Rs.50, 000. Almost half of the milk producers (46 per cent) are rearing "one to two" cattle in their sheds and another one third of them are rearing "three to four" cattle to make their living together with the agricultural profession. In total, 82 per cent of the milk producers have got less than 4 milching cattle.

Since dairying is not lucrative, the milk producers get it difficult to work on full time basis in the profession and unable to nurture more than two milching cattle in their sheds. Some of the milk producers rear more than this herd size, where they are supported by higher landholdings. Within the herd size of "one to two" two third of the milk producers have either an indigenous cow or a crossbred cow. But in the same category jersey cows are quite common and have got shelter in a whopping two third of the dairy farms. In all other cattle size, jersey cows are more popular than any other cows and buffaloes. It is found that, buffaloes are not very common in dairy farming which are reared by only six per cent of the milk producers. As far as the cattle combinations are concerned jersey-indigenous and jersey-crossbred are the two popular ones among the milk producers (two third cases).

Keeping view to the marketable surplus of milk, it is the initiative of the dairy federations or the district milk unions who set up the collection centres or societies in the villages to procure milk from the dairy producers. It is seen from the above table that two third of the dairy producers travel less than one km to deliver their produce at the societies. The popular means of travelling to the society is either “cycle” or “walking”.

1.8.5B: Profile of cooperative societies and bulk milk coolers

Secretaries constitute 71 percent of the target respondents whereas the rest 29 percent of the respondents are presidents, supervisors and the head loaders. Dairying is basically a women centric activity, so efforts have been made by the federation and Govt. of India as a whole to attract more and more women to the dairying profession. On this basis, slightly more emphasis is given to WDCS (Women Dairy Cooperative Societies, 53 percent) comparing to their male counterpart in MDCS (Men Dairy Cooperative Societies, 47 percent). It is seen from the table that, almost 80 percent of the respondents are under the age group of 20 to 40 years. As far as literacy is concerned more than 90 percent of them are either High School Certificate (HSC) or college qualified except the head loaders in certain cases.

Opinions of the sample respondents have been taken upon the background of the DCS formulation. It is seen from the table 1.15 that, high marketable surplus of milk in a particular area is the major driver (58 percent cases) of DCS formulation whereas the union initiative comes next by making it to 40 percent cases. Rests of them have been set up with an intention of getting self employment through this and is an initiative of unemployed locals. Almost 60 percent of the DCSs are found to be registered whereas the rest are not registered but functioning at par with the registered DCSs. Around 80 percent of DCSs are found to be covering around three to five revenue villages as their adjoining area of operation.

The concerned union Balasore-Bhadrak Milk Union Ltd. (BBAMUL) was functioning under the Dept. of Animal Husbandry & Veterinary Services initially and later on handed over to the federation. During the year 2006 it was merged with the Mayurbhanj District Cooperative Milk Producers’ Union Ltd. (MAMUL) and renamed as Balasore, Bhadrak & Mayurbhanj Milk Union Ltd. (BBAMMUL). During the year 2008 it was further de-merged from the said to be known with its earlier brand BBAMUL. Currently there are two such unions viz. BBAMUL and MAMUL serving the production plant in milk procurement in their jurisdictions. The basic objective of the unions is to facilitate round the year milk marketing on behalf of the rural milk producers by providing them various inputs of dairy farming at an affordable (subsidised) price. The unions raise their funds through collection of entrance fees from the DCSs, shares and debentures etc. to fulfil their financial requirements. Usually the DCSs hold at least one share of worth Rs.100 at the unions by paying the same and Rs.5 towards the entrance fee. The member of the unions can be expelled by means of a resolution passed by two third of existing members in the general body meeting, if found unsuitable to work with them at any given point of time.

Table 1.15: Profile of cooperative societies and bulk milk coolers

<table>
<tr><th colspan="3">Dairy Cooperative Society (DCS)</th><th colspan="3">Bulk Milk Cooler (BMC)</th></tr>
<tr><th>Demographics</th><th>Category</th><th>Frequency</th><th>Demographics</th><th>Category</th><th>Frequency</th></tr>
<tr><td rowspan="4">Contact person</td><td>Secretary</td><td>119 (70.8)</td><td rowspan="3">Contact person</td><td>Plant-in-charge</td><td>18 (54.5)</td></tr>
<tr><td>Supervisor</td><td>22 (13.1)</td><td>Supervisor</td><td>4 (12.1)</td></tr>
<tr><td>President</td><td>14 (8.3)</td><td>Operator</td><td>11 (33.3)</td></tr>
<tr><td>Head loader</td><td>13 (7.7)</td><td rowspan="5">Capacity of the plant (litres/day)</td><td>500</td><td>1 (3.0)</td></tr>
<tr><td rowspan="2">Gender</td><td>Male</td><td>79 (47.0)</td><td>1,000</td><td>20 (60.6)</td></tr>
<tr><td>Female</td><td>89 (53.0)</td><td>2,000</td><td>10 (30.3)</td></tr>
<tr><td rowspan="3">Age (years)</td><td>Less than 20</td><td>3 (1.8)</td><td>3,000</td><td>1 (3.0)</td></tr>
<tr><td>20 to 40</td><td>130 (77.4)</td><td>5,000</td><td>1 (3.0)</td></tr>
<tr><td>40 to 60</td><td>35 (20.8)</td><td rowspan="4">Name of the project under which the BMC is set up</td><td>IDDP</td><td>27 (81.8)</td></tr>
<tr><td rowspan="3">Education</td><td>Primary</td><td>13 (7.7)</td><td>CMP</td><td>3 (9.1)</td></tr>
<tr><td>High School</td><td>85 (50.6)</td><td>SGSY</td><td>2 (6.1)</td></tr>
<tr><td>College</td><td>70 (41.7)</td><td>DRDA</td><td>1 (3.0)</td></tr>
<tr><td rowspan="3">Reason behind society formulation</td><td>Marketable surplus of milk</td><td>98 (58.3)</td><td rowspan="2">Infrastructural status</td><td>Own house</td><td>22 (66.7)</td></tr>
<tr><td>Union initiative</td><td>62 (36.9)</td><td>Rented house</td><td>11 (33.3)</td></tr>
<tr><td>Self-employm.</td><td>8 (4.8)</td><td rowspan="5">Total assets (Rs. millions)</td><td>Less than 0.5</td><td>5 (15.2)</td></tr>
<tr><td rowspan="2">Registration status</td><td>Registered</td><td>104 (61.9)</td><td>0.5 to 1.0</td><td>23 (69.7)</td></tr>
<tr><td>Unregistered</td><td>64 (38.1)</td><td>1.0 to 1.5</td><td>3 (9.1)</td></tr>
<tr><td rowspan="3">Villages covered (nos)</td><td>Less than three</td><td>66 (39.3)</td><td>1.5 to 2.0</td><td>1 (3.0)</td></tr>
<tr><td>three to five</td><td>69 (41.1)</td><td rowspan="2">More than 2.0</td><td rowspan="2">1 (3.0)</td></tr>
<tr><td>More than five</td><td>32 (19.6)</td></tr>
</table>

In more than half of the cases the plants-in-charge are found absent in their offices and hence could not be contacted. Due to various tasks assigned to them by the union they move frequently to the field and to the union offices. Hence the operators of the plants are contacted mostly to collect data regarding the bulk milk cooler/chilling centre operations.

Both the plant-in-charges and the supervisors constitute around half of the responding population in this segment.

Out of 33 BMCs studied, 20 are 1,000 litre capacitated (60 percent) whereas 10 are 2,000 litre capacitated plants (30 percent). Other 10 percent of the chilling plants are from different categories as mentioned in the table. Keeping view to the marketable surplus of milk in a particular area the BMCs are set up by receiving funds from various central or state government agencies. The Central Government and National Dairy Development Board (NDDB) are the major sources of funding to the dairy federations through various projects like IDDP (Integrated Dairy Development Programme), CMP (Clean Milk Production) and SGSY (Sampurna Grameen Sworojgar Yojana) etc. two third of the BMCs are found to be operating in their own buildings with an asset level of Rs.0.5 to 1.0 million. Higher capacitated plants are found basically in high milk yielding areas and usually less in nos.

1.8.5C: Brief profile of production plant

The 50,000 litres capacitated dairy plant which caters the needs of three districts produces wide range of products. The dairy plant is running with the financial assistance from the Government of India under its IDDP-V scheme. Initial capacity of the plant after being sponsored by the IDDP-V scheme of Government of India is 50,000 litres per day and is projecting to expand with a processing capacity of 75,000 litres per day.

Table 1.16: Profile of production plant

Particulars	Unit	Figures/values
Annual sales turnover (approx)	Rs. million	60.0
Initial outlay	Rs. million	100.0
Processing capacity (milk)	Litres per day (LPD)	50,000
Employee strength	Nos	107
Milk unions	Nos	2
Av. machine running time	Hours	12.0

The average machine running time is found to be 12 hours per day and on an average it is currently processing 35,000 litres of milk. Under its further expansion scheme it is aiming at to produce ice cream and ghee which are currently procured from Bhubaneswar dairy for distribution in the marketing areas of the dairy. As far as the milk procurement is concerned there are two milk unions namely BBAMUL & MAMUL assisting the dairy and the help of Cuttack milk union is usually sought in distress.

1.8.5D: Profile of transporting agencies (Third Party Logistics Provider – TPLP)

Table 1.17: Profile of third party logistics providers

In-bound logistics		No. of marketing sub-routes	22
No. of milk routes	15	No. of vehicles in operation	22
No. of vehicles in operation	11	No. persons employed	52
No. persons employed	25	Distance covered/day (kms)	2,716
Distance covered/day (kms)	2,284	Insulation charges/month/vehicle (Rs.)	1,500.00
Out-bound logistics		Av. operating cost/km (Rs.)	7.16
No. of marketing routes	07	Average receipt/km (Rs.)	7.60

The table 1.17 depicts the overall summary of the transportation process. Both the in-bound and the out-bound logistics have been mentioned in that. In-bound logistics (procurement) is a function of the unions and the out-bound logistics (distribution) is taken care by the production plant through the third party logistics providers. For the out-bound logistics there are two transport agencies namely Panda and Sabitri transporters Ltd.

1.8.5E: Demographic profile of retail agents and customers

In this study, 150 numbers of retailers have been considered across three districts. Retailing in the study areas found to be a male centric activity – thus the dominance of the same is reflected in more than 90 percent of the cases. The average age of a retailer found to be around 40 years wherein two third of them are in the age group of 20 to 40 years. In the similar way, two third of them are found to have studied up to college level.

While taking the opinions of the retailer-respondents on the reason for retailing, 60 percent of them have opined for high demand and brand image of the federation being taken together. Low investment and high profit margins of the products have been opined by more than 20 percent of the retailers. Taken together, these four variables get responsible for more than 80 percent of the opinions pertaining to "reason for retailing the highly perishable products". The low investment factor is also reflected in the next query wherein more than half of them opine that, their investment falls below Rs.25,000. With this small investment, they could be able to manage their businesses with having one outlet (93 percent case) situated mostly in the urban areas.

Table 1.18: Demographic profile of retail agents and customers

Retailer		
Demographics	Categories	Frequency
Gender	Male	137 (91.3)
	Female	13 (8.7)
Age (years)	20 to 40	91 (60.7)
	40 to 60	55 (36.7)
	60 and above	4 (2.7)
Education	Read and write	2 (1.3)
	Primary	48 (32.0)
	HSC	45 (30.0)
	College	55 (36.7)
Association with the federation (years)	Less than 5	63 (42.0)
	5 to 10	67 (44.7)
	10 to 15	16 (10.7)
	More than 15	4 (2.7)
Reasons for retailing the products	High demand	42 (28.0)
	Low investment	17 (11.3)
	High profit margin	16 (10.7)
	Brand image	49 (32.7)
	Business expansion	11 (7.3)
	Self employment	15 (10.0)
Investment (Rs.)	Less than 25,000	83 (55.3)
	25,000 to 50,000	31 (20.7)
	50,000 to 75,000	19 (12.7)
	75,000 to 100,000	12 (8.0)
	More than 100,000	5 (3.3)
Retail outlets owned	One	140 (93.3)
	Two and above	10 (6.7)

Customer		
Demographics	Categories	Frequency
Gender	Male	294 (90.7)
	Female	30 (9.3)
Age (years)	Less than 20	52 (16.0)
	20 to 40 years	145 (44.8)
	40 to 60 years	92 (28.4)
	More than 60 years	35 (10.8)
Education	Illiterate	0 (0.0)
	Read and write	7 (2.2)
	Primary	11 (3.4)
	HSC	78 (24.1)
	College	228 (70.4)
Occupation	Service	132 (40.7)
	Business	124 (38.3)
	Professional	57 (17.6)
	Others	11 (3.4)
Monthly income (Rs.)	Less than 10,000	16 (4.9)
	10,000 to 20,000	100 (30.9)
	20,000 to 30,000	112 (34.6)
	30,000 to 40,000	62 (19.1)
	More than 40,000	34 (10.5)
Size of the family (nos)	Two or less	8 (2.5)
	Three to five	208 (64.2)
	Six to eight	91 (28.1)
	Nine or more	17 (5.2)
Mode of purchase	Counter purchase	168 (51.9)
	Home delivery	156 (48.1)

Among the customers surveyed, above 90 percent of them are males whereas only 10 percent found males. Almost half of the population studied are in the age group of 20 to 40 (45 percent) and approximately one third of the sample respondents covered within 40 to 60 years of age. More than one third of the sample respondents have gone up to the college level in their studies. Not a single person is found to be illiterate, who purchases packaged milk/products. The table above depicts that almost 80 percent of the respondents are either service holder or businessman.

As long as the monthly income of the respondents are concerned, it is seen that two third of the population have got their income within the range of Rs.10,000 to Rs.30,000. The rest of the sample respondents found to have been from other income groups. It is hard to find somebody, who purchases packaged milk and allied dairy products with monthly income of less than Rs.10,000.

Almost two third of the customers are found to have three to five members in their families with an average family size of five and a standard deviation of one member. When it comes to mode of purchase of milk, the same proportion is detected with counter purchasing as well as home delivery (50 percent in each case).

1.9 Data Analysis

Both the collected primary and secondary data are analysed using correlation, regression, factor analysis, inferential statistical tests etc. with the help of IT tools such as MS Excel and Statistical Package for Social Sciences (SPSS-14/17). Wherever required frequency and cross-tabulations have been generated but keeping view to the stakeholders and continuous variables in their case – mean, standard deviation and coefficient of variations are used by minimising the former. In some cases one category of the stakeholder (say milk producers) are treated to be one component of the supply chain and analysed accordingly while giving due weightage to their individual characteristics. The concepts of multiple regressions and factor analysis as reflected in the analysis are depicted below to avoid repetitions in the forthcoming chapters.

1.9.1 Multiple regression

Multiple regression techniques are greatly referred to fit the various models discussed in the study and hence a little bit of concepts on this topic is cited here to understand the way they are used. Out of the seven different stakeholders, in five cases the multiple regression concepts are used and in rest of the cases the mean has been used. It may be mentioned here that due to lesser number of responses and high collinearity or auto-correlations the chance of common method bias (CMB) can't be avoided. No proper result comes up in ANOVA when there is a high collinearity or auto-correlation. In those cases the though mean is a second best option still has been taken into consideration to avoid biasness. Basically in this study for the production plant and the transporting agencies responses mean (coefficient of variation) has been used wherever required. In all other cases the multiple regression techniques are followed with due importance to the descriptive like mean, standard deviation, coefficient of variation etc.

The difference between the "R square" and "adjusted R square" values indicates how close the model fits if the responses have been drawn from the population instead of the sample (Field, 2008). For example if for a test R square is 0.90 and adjusted R square is 0.85 then the difference is 0.05 (five percent) which is not addressed by the model. The lower the difference the higher is the scope of model fit with the use of the sample data. The residuals are the values which are not being addressed by the models and together with the regression values equal 100 percent.

The higher is the t value and lower is the significant value (less than 0.05 or so) for a particular variable then it is highly an essential predictor for the model. The comparison for the variables can be done with the help of both unstandardised and standardised coefficients and hence keeping view to the situations they are used in the analysis. The F-statistic says the improvement in the outcome (except consideration of mean) coming out of the model should be more than that of the existing inaccuracy that is to say the ratio of improvement to inaccuracy should be more than 1.0. Hence wherever the model seems to be fitted well with respect to the predictors, the F-statistic must be greater than 1.0.

Both the concepts of auto-correlation and multi-collinearity have been used in the analysis. In case of auto-correlation the Durbin-Watson value is requested which closer to 2.0 gives a better result stating that there is no auto-correlation in the model. In the similar way to avoid the collinearity - tolerance (more than 0.2) or the variance inflation factor (VIF inverse of tolerance) have been used. The VIF must be lesser than 5 (tolerance value more than 0.2) else the possibility of collinearity is expected and hence the data may be biased. But in social science research in some cases this is acceptable up to 10 (Gaur & Gaur, 2009).

1.9.2 Factor analysis

In the analysis chapters before getting into the factor analysis, the following measures are found and tested with the preliminary conditions. Wherever the conditions are found to be satisfied, the concept is used else dropped. According to Field (2005):

- Determinant of the Correlation Matrix should be more than 0.00001
- Kaiser Meyer Olkin Measure should be more than 0.5
- Bartlett's Test of Sphericity should be satisfied

1.10 Scope of the Research

It is estimated that only about five percent of the milk market is handled by the organised sector in Orissa (IFCN, FAO, 2004) and the rest 95 percent is unorganised. O is a major contributor in the organised milk sector in the state covering all the 30 districts. It has a vast milk producer network organised into the dairy cooperative societies. The operation of this public sector organisation is replicating the "Anand Pattern" of dairying. The samples from various categories are chosen scientifically so as to avoid biasness. The study with its major findings on basic supply chain operations, risks, coordination and performance issues will definitely add value to the existing literature and will show new directions to work upon.

1.11 Limitations of the Research

The study has been confined to the state of Orissa only. Though all the federations across the country follow the "Anand Pattern" of milk procurement, processing, and distribution still the performance of the federations is not alike and there are lots of disparities among them. The miniature sample size may not be a proper representation to the whole scenario and could bias the applicability of the results. The objectives of the study can be further modified to bring a clearer picture of the industry. The study can be extended to the other dairy food supply chains in the country and the results can be compared to enlighten the concepts of dairy food supply chain. Unorganised sector in the field of milk production and distribution has been untouched.

1.12 Chapterization of the Dissertation

The whole thesis is subdivided into eight chapters. Chapter I contains basic dairy issues across the world with special reference to Indian dairy scenario. Problem definition, research gaps, objectives, hypotheses, research methodology and demographic profile of the respondents have been mentioned clearly. Limitations and directions for future research with the references cited in the chapter are also depicted. Chapter II discusses about the views of researchers, academicians and practitioners on supply chain issues are cited categorically under the subheads of basic issues, risks, coordination and performance. Supply chain issues from the dairy industry perspectives are also indicated thereto. Chapter III discusses about the conceptual framework of supply chain issues. The issues mentioned here are referring to various concepts of supply chain and dairy industry. Chapter IV to VII are indicating the analysis of the primary and secondary data in the industry. Chapter IV discusses about the ongoing supply chain practices in the dairy industry with reference to the procurement functions. Chapter V has also discusses about the ongoing practices but refers to the production and distribution related issues. Chapter VI refers to the analysis of risks and uncertainties in the dairy whereas chapter VII discusses about the coordination and performance issues in the dairy food supply chain as a whole. Chapter VIII is pertaining to the summary and conclusion (findings) part of the analysis with recommendations to improve the sector further.

1.13 References

Ashok Kumar, P., & Sayulu, K. (2007, December). Procurement and processing practices of dairy products – A study of Karimnagar dairy. *SEDME, 34*(4), 57-71.

Banerjee, A. (2008). Indian milk products export. *Indian Dairyman, 60*(5), 23-25.

Barman, K., Konwar, D., & Kumar, R. (2008). Scientific management – A road to profitable dairy farming. *Indian Dairyman, 60*(10), 68-73.

Carmines, E. G., & Zeller, R. A. (1979). *Reliability and validity assessment*. Beverly Hills, CA: Sage Publications.

Chopra, S., & Meindl, P. (2003). *Supply chain management: Strategy, planning and operation*. New Delhi: Pearson Education.

Department of Animal Husbandry, Dairying and Fisheries, Government of India. (2008). *Dairy Statistics*. New Delhi: Author. Retrieved July 15, 2009, from http://www.dahd.nic.in/

Easton, G. (1998). *Case research as a methodology for industrial network: A realist apologia*. Network Dynamics in International Marketing, New York, NY: Pergamon Press.

Eisenhardt, K. (1989). Building theories from case study research. *Academy of Management Review, 14*(October), 532-550.

Field, A. P. (2005). *Discovering statistics using SPSS* (2nd ed.). London: Sage.

Food and Agricultural Organisation (2007). *FAO predicts continued rise in cereal, dairy prices*. Retrieved November 7, 2008, from http://www.fao.org

Gaur, A. S., & Gaur, S. S. (2009). *Statistical methods for practice and research: A guide to data analysis using SPSS* (2nd ed.). New Delhi: Sage Publications Ltd.

Ghanekar, D. V. (2008). Taxing dairy coops: A case for reconsideration. *Indian Dairyman, 60*(3), 108-111.

Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1998). *Multivariate data analysis*. London: Prentice Hall.

Household Consumer Expenditure in India 2006-07, NSS 63rd Round (July 2006 – June 2007), National Sample Survey Organisation, Ministry of Statistics and Programme Implementation, GOI, http://mospi.nic.in/nsso_test1.htm

IFCN. (2008). *IFCN dairy report: For a better understanding of milk production world-wide*. Kiel, Germany: Author. Retrieved April 12, 2009, from www.ifcndairy.org

Indian Council of Agricultural Research. (2002). *Handbook of animal husbandry*. New Delhi: Author.

Juran, J. M. (1988). *Quality planning and analysis*. New York: McGraw-Hill

Khanna, R. S. (2008). Ensuring revolution in milk production system: Getting the best from the India's cattle and buffaloes. *Indian Dairyman, 60*(3), 37-43.

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement, 30*, 607-610.

Malhotra, M. K., & Grover, V. (1998). An assessment of survey research in production and operations management: From constructs to theory. *Journal of Operations Management, 16*, 407-425.

McDougall, P. P., & Robinson, R. B. Jr. (1990). New venture strategies: An empirical identification of eight 'Archetypes' of competence strategies of entry. *Strategic Management Journal, 11*(6), 447-467.

Miles, M. B., & Huberman, A. M. (1994). *Quantitative data analysis*. Thousand Oaks, CA: Sage Publications.

Nataraj, B. S. (2005). *Marketing of milk and milk products opportunities for entrepreneurship*. Karnal, Gurgaon: National Dairy Research Institute.

Nunnally, J. C. (1978). *Psychometric theory*. Englewood Cliff, NJ: McGraw-Hill Publications.

Philips, J. (1981). Assessing measurement error in key informant reports: A methodological note on organisational analysis in marketing. *Journal of Marketing Research, 18*, 395-415.

Planning Commission, Govt. of India. (2001, August). *Draft report of the working group on animal husbandry and dairying for five-year plan (2002-2007)*. New Delhi: Author.

Prasad, J. (2005). *Principles and practice of dairy farm management*. New Delhi: Kalyani Publishers.

Ramaiah, M. J. (2008). Rural development through dairy farming. *Indian Dairyman, 60*(5), 64-67.

Rao, S., & Sharma, K. P. (2003). Problems of dairy cooperatives in (Urmul) Bikaner, Rajasthan. *Indian Dairyman, 55*(11), 41-47.

Saravanakumar, V., & Jain, D. K. (2008). Economic analysis of milk production in Tamil Nadu. *Productivity, 48*(4), 408-414.

Shah, J. (2009). *Supply chain management: Texts and cases*. New Delhi: Pearson Education.

Shapiro, J. F. (2001). *Modelling the supply chain*. Duxbury: Pacific Grove.

Teng, S. G., & Jaramillo, H. (2005). A model for evaluation and selection of suppliers in global textile and apparel supply chain. *International Journal of Physical Distribution & Logistics Management, 35*(7), 503-523.

Thirunavukkarasu, D., & Sudeepkumar, N. K. (2006). Comparative profile of milk producers in different marketing systems. *Journal of Rural Development, 25*(1). 49-65.

Vaswani, L. K. (2008). Promoting value added traditional dairy products – Alternative business models. *Indian Dairyman, 60*(3), 118-122.

Voss, C., Tsikriktsis, N., & Frohlich, M. (2002). Case research in operations management. *International Journal of Operations & Production Management, 22*(2), 195-219.

Yin, R. K. (2003). *Case study research, design and methods* (3^{rd} ed.). London: Sage Publications.

CHAPTER II

REVIEW OF LITERATURE

Starting from the ancient stone era human has had tried to make his living easy and subtle by removing uncertainties and minimising risks. Today's business is also no deviation. Keeping view to the enormous competition in the market place and the excessive political & bureaucratic interventions the organisations are striving hard to overcome uncertainties and risks which are leading to shorter product life cycles and a great deal of customer distraction towards the product or service. That's the reason why the organisations are formulating and implementing various strategies (Mintzberg, 1980) to overcome these barriers. In this regard, the supply chain and logistics have emerged as most sought after strategies in the organisations. To support the argument - views of some of the theoreticians and the practitioners have been hereunder mentioned under different heads pertaining to supply chain management and its usefulness to dairy industry.

2.1 Introduction to Supply Chain Management

A supply chain consists of all parties involved directly or indirectly in fulfilling a customer request. The supply chain not only includes the manufacturer and suppliers but also transporters, warehouses, retailers and customer themselves (Chopra & Meindl, 2003). In contrast to this supply chain management (SCM) is a set of approaches utilised to efficiently integrate suppliers, manufacturers, warehouses and stores so that the merchandise is produced and distributed at the right quantities, to the right locations and at the right time. The basic objective of the SCM is to minimise system wide costs while satisfying service level requirements. While designing the strategies it is essential to involve all the stakeholders in the system to reach at an optimal one and if designed autocratically then the cost could be higher by incurring losses (D. Simchi-Levi, Kaminsky, E. Simchi-Levi., & Shankar, 2008).

Most of the supply chains are found incapable to minimise the overall cost due to various reasons. Lee (2006) expresses concern over the deterioration of supply chain over time even if it is highly focused on cost minimisation and responsiveness. After fifteen years of studying more than sixty companies he has reached at the conclusion that supply chain should be agile, adaptable and aligned in order to survive for a longer period of time. To add value to the argument of agility instead of cost cutting, a famous quotation by "Warren Buffet" is presented below. It says,

> "…..Whenever I read about some company undertaking a cost-cutting program, I know it's not a company that really knows what costs are about. The really good manager does not wake up in the morning and say 'This is the day I'm going to cut costs', any more than he wakes up and decides to practice breathing."

According to this, instead of giving too much emphasis on cost cutting it is rather required to improve the overall value of the supply chain. Another important objective of the supply chain is to maximise the customer satisfaction. Kotler (2008) defines customer satisfaction as the consumer's feelings of pleasure or disappointment resulting from a comparison between the perceived performance of the goods or services and the prior expectations. Happy customers are those who get what they expect – or more. According to him the customer satisfaction can be defined by the formula:

Perception – Expectation = Satisfaction

If perception is greater than the expectations then the customer satisfaction is positive and hence the product or the service performs better than what it is expected. In the similar way, if the result is negative then the customer satisfaction is found to be negative which requires further attention of the company to improve the former. Customer satisfaction greatly influences by the quality of the product or service and price-quality match (Juran, 1988; Teng & Jaramillo, 2005; Ramaiah, 2008). Higher is the customer satisfaction higher is the performance of the supply chain and hence should be viewed seriously in order to improve the performance level of it (Kano, Seraku, Takahashi, & Tsuji, 1996).

2.1.1 Flows and drivers of a supply chain

The various flows and drivers of a supply chain are depicted in the figure 2.1. In context to this some of the views of researchers are cited.

According to Ayer (2001) there are four flows of a supply chain namely physical-, information-, financial- and knowledge flows. The physical flow of the supply chain depends upon three basic drivers namely facilities, inventory and transportation. Facilities are the places where the items are manufactured and stored - basically the production and storage sites; inventory constitutes all raw materials procured from the suppliers or by own, semi-finished and finished items. It exists in the supply chain because of the demand fluctuation situations. And the inbound and outbound logistics entangles the flow of materials to the plants and flow of items to the end users through the proper mode of transportation (Cox, Ireland, Lonsdale, Sanderson & Watson, 2001). Finance flows encompasses the series of financial relationships that start with the customer buying the product or service at a given price and ultimately the revenue generated out of it is allocated to the various stakeholders of the supply chain (Cox, 1997). Today's markets are changing at an alarming speed.

In order to keep track of the market places better, rapid gathering and disseminating of information is inevitable. In this context the information flow in the supply chain includes the market signalling amongst the supply chain members regarding the end user preferences (Westgren 1998). On the other hand the knowledge flow is the intellectual input into in the supply chain which leads to the added value in the product or service (Ayers, 2001). Product, process and service innovations are the result of the knowledge flow. Supply chain material, finance and information flows are inter-related and hence one has an impact on the others.

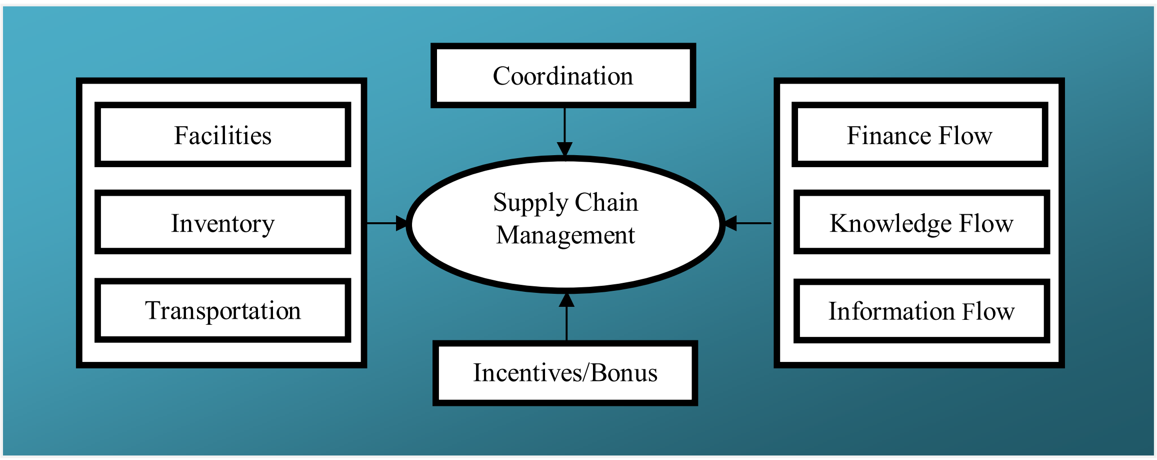


Figure 2.1: Drivers of supply chain

Kaipia (2007) tries to address two issues namely; choosing of coordination mechanism to match demand & supply and balancing between material flow and information flow by the use of chosen mechanism. As long as the coordination mechanism is concerned it is required to have accuracy in information sharing and flexibility in operational planning to keep the gap between supply and demand as minimum. Frequent planning updates and varying planning processes, lack of planning capability, inadequate information or inability to use shared information are the major reasons for the imbalance between the material and information flows. Hence together with the four flows, it is highly essential to have proper coordination and incentive sharing mechanism in the supply chain design and operations (Westgren, 1998; Boehlje, 1999)

Distorted or inaccurate information brings a great deal of problem leading to supply chain inefficiency. There are four major causes of this effect (called bullwhip effect) namely:

- Lack in demand forecast updating
- Order batching (periodic or push ordering where periodic ordering varies from time to time)
- Price fluctuations
- Rationing (demand exceeds supply) and shortage gaming (ordering with multiple suppliers and receiving the order which is delivered first

In order to curb the bullwhip effect in the supply chain, it's highly essential to understand the root cause of the problem and strategies should be formulated accordingly to tackle it. Nevertheless proper information sharing mechanism (Lajara & Lillo, 2004), channel alignment and improved operational efficiency of the organisation can tackle the bullwhip effect (Lee, Padmanabhan, & Whang, 1997).

2.1.2 Theories supporting supply chain management

Traditionally the business organisations were inventory-driven focusing on to supply the product continuously to the market place without much customer orientation. But after the competition gets stiffened the idea was no more enduring giving rise to the concept of supply chain management. The supply chain management was first developed by Oliver (1980) to address the issues of procurement, production and distribution.

There are two different schools of thought on supply chain management concept viz. (i) the integration school of thought and (ii) the network school of thought. Jones and Riley (1987) as well as Ellram and Cooper (1990) have cited about the integration of thought mentioning about the interlinking of the organisations and their functions to increase the level of value to the customers. On the contrary the network school of thought have cited about the relationships and alliances. Supply chain management is relatively a new concept in the field of management. The concept over a period of time developed from other disciplines of economics, marketing, and organisational strategy etc. Some key management theories based on these disciplines are discussed hereunder.

Table 2.1: Theories supporting supply chain management

Author(s)	Year	Focus	Field	Summary of relevant content
Von Bertalanffy	1950	General Systems Theory	Physical Sciences	According to this theory all businesses are systems comprising of several processes. If one component of the system is disturbed then the whole system might collapse. The theory is one of the key theories which describe the supply chain management.
Penrose	1959	Resource Based Theory (RBT)	Strategic Management	The theory views firms as a bundle of resources. The theory highlights effective management of firm's resources, productive opportunities and diversification strategy for competitive advantage.
Williamson	1975	Transaction Cost Economics (TCE)	Economics	The concept of TCE is based on the company's 'make or buy' decisions. The theory says about the total cost incurred by a firm for various heads can be grouped into mainly transaction cost (buy) and production cost (make). These two decisions are crucial for the firm's ultimate profit and revenue.
Jensen and Meckling	1976	Agency Theory	Economics	The theory speaks of the contractual agreements and relationships that exist between the service providers (agents) and the companies (principals) to prevent risk.
Pfeffer and Salancik	1978	Resource Dependence Theory (RDT)	Organisational Studies	The procurement of external resources is vitally important for any company. The External Control of Organisations: A Resource Dependence Perspective by the authors highlights the issues of production strategies and the external organisational links.
Porter	1980	The Value Chain Concept	Industrial Economics	The value of the firm's output for which a customer is willing to pay against a certain amount that is price. The major task here is to add value to each segment of the organisational processes.
LaLonde	1984	Inventory Vs. Information-Sharing Trade-off	Industrial Economics	This cites the importance of the information systems. Instead of maintaining a huge inventory it suggests to optimise the inventory level by using the information systems which in turn can deal with the uncertainties and the demand fluctuations.

Sources: Jensen and Meckling (1976); LaLonde (1984); Penrose (1959); Pfeffer and Salancik (1978); Porter (1980), Von Bertalanffy (1950); Williamson (1975)

2.2 Supply Chain versus Logistics

Traditionalist view says supply chain is a part of logistics whereas Unionist view opposes it saying that logistics is a part of the supply chain. Inter-sectionist view says that some concepts of supply chain and logistics are same whereas there are lot of functions of supply chain which do not come under the purview of logistics and vice-versa. Relabeling view depicts that logistics is now supply chain management (Christopher, 1998; Simchi-Levi et al., 2000; Stock & Lambart, 2001; Mentzer et al., 2001, Larson & Halldorsson, 2002, Mitra, 2008).

Supply chain management is a strategic issue where as logistics is more operations oriented. Supply chain management focuses on facilities, inventory and transportation with the help of funds, information and knowledge. But the scope of logistics is limited to the transportation and storage of goods in the firm. Wherever supply chain management is a white collar job, the logistics is perceived to be a blue collar job. But keeping view to the logistics functions, it is one of the core functions of the supply chain. The whole system fails if the logistics in the supply chain fails. Since logistics is a part of the whole supply chain it can be treated to be subset of the supply chain (Council of logistics management, 1998).

However, Council of Logistics Management (1998) defines that, "logistics is the part of supply chain processes that plans, implements and controls the efficient flow and storage of goods, services and related information from the point of origin to the point of consumption in order to meet the customers' requirements". Logistics has an impact on supply chain management and hence is an integrated part of it (Monczka et al., 2002). Supply chain entangles logistics along with the market research, sales & promotions, information gathering, R&D, product design, new product development etc. (Bechtel & Jayaram, 1997; Bowersox, 1997; Ellram & Cooper, 1990).

2.3 Purchasing in Supply Chain

Purchasing plays a vital role in the sustenance of any supply chain (Tiersten, 1989; Monczka et al., 2002). Cost reduction or improvement, improved material delivery, shorter cycle time, development cycle times, access to product/process technology and quality improvement etc. could be practiced with an efficient purchasing operation in the organisation. Presutti (2003), Lo and Yueng (2004) reveal that 50-70 percent of the sales revenue or manufacturing cost is spent on sourcing of raw materials, components and finished goods/services. Hence in order to make the process successful it is highly essential to look after the following steps:

- ❖ Due attention in selecting suppliers

- ❖ Proper evaluation mechanism for performance
- ❖ Raising performance levels by hiking the expectation level
- ❖ Performance based incentives
- ❖ Field visits to the suppliers' firms
- ❖ Training and education in regular intervals
- ❖ Identifying suppliers' problems and solving them
- ❖ Financial assistance to the suppliers

But in most of the cases due attention is not given to the above factors and hence the procurement process becomes sub-optimal and less value additive to the supply chain. Earlier purchasing has been treated to be an operational and tactic level function but today it is viewed as a strategic issue.

It is experienced that strategic management of purchasing may reduce total expenditure by 5-15 percent over a period of three years (Biemans & Brand, 1995). The advantages of strategic sourcing have been manifold and impact the supply chain performance positively. Strategic supplier partnership, sourcing flexibility, supplier evaluation and trust among the supply chain partners are the key dimensions of the strategic sourcing (V. H. Pooler, & D. J. Pooler, 2004). Variables like enterprise resource planning, process and design, sourcing policies, competency development and strategic sourcing of the organisations can also be taken into consideration to increase the scope of strategic sourcing (Khan & Pilania, 2008).

Cost cutting, quality improvements, standardisation and supplier base reduction etc. are some of the most important characteristics in strategic sourcing these days. Cost pressure, supplier base reduction and maintaining good relationships with the suppliers are the strategies found to be followed in switching from multiple sourcing to the single sourcing. In contrast, uncertainty of future supply, need for quality improvement and better purchasing price are the causes found in switching from single to multiple sourcing (Faes & Matthyssens, 2009). There is no rule of thumb in this field as it varies from product to product and from organisation to organisation as per the requirements. So it is essentially required to have proper knowledge & skills (especially leadership) of the sourcing person which positively influence the strategic sourcing (Carr & Smeltzer, 1999; Loarne, 2005).

Various activities like supplier identification, evaluation, selection, management, development and improvement are the key issues relating to procurement process in the organisation (Monczka et al., 2002; Pooler et al., 2004; Gunasekaran, Patel, & McGaughey, 2004). It has been seen that there is a positive relationship between supplier development and supply chain performance (Sanchez-Rodriguez, 2005).

2.4 Dairy Farming

Dairy farming is a perennial source of income for the people who are especially below the poverty line and practice it as a subsidiary profession along with agriculture and cultivation in rural areas. Unlike any other crops it is source of income throughout the year and hence seen to be surpassing traditional wheat and rice cultivation (Ghanekar, 2008). It is also seen that one fourth of the annual income of the families in the rural areas comes from dairying only (Misra & Pal, 2003). Keeping view to the grass root development it can be said that dairying can be a major contributor to the sustainable development of a country.

The contribution of livestock to Gross Domestic product (GDP) has increased from 4.8 percent in 1980-81 to about 5.6 percent in 1999-2000 – depicting an upward trend in Asia. Because of lack of subsidies to the sector as a whole, the industry is not showing a substantial improvement like developed countries and hence it is unable to compete with the global dairy industry in terms of quality and productivity. The success of cottage dairy industry mainly depends upon the enhancement of milk production through improved feeding, breeding and healthcare services.

The improvement of health services to the animals and to insuring them against diseases should be taken as priority in order to see the sector progressing. In this connection the government should come forward to provide subsidies like European and American countries to take the industry ahead. The agricultural policies should be formulated accordingly and hence subsidies/incentive sharing mechanism should be brought under practice to compensate the loss incurred by the milk producers or the industry as a whole. The idea behind this is to minimise the demand-supply gaps and price-quality mismatch by encouraging quality milk production (Khanna, 2005; Ramaiah, 2008).

A comparative study from Painter (2007) has revealed that even though Canada and New Zealand are doing well in the dairy farming sector still there are some basic differences between them. Whereas New Zealand dairy farmers are operating in a free and competitive market with no government subsidies, the Canadian dairy sector is restricted and little subsidised. Because of New Zealand's free and competitive environment in the sector, it has captured 40 percent of the dairy export market in the world.

The company Fonterra of New Zealand is the top dairy processor in the world with milk intake of 18.6 million tonnes per annum (IFCN, 2008). As a result of free and economic environment in the segment New Zealand's dairy farmers have good income comparing with the average net worth of all families in New Zealand. Dairy farmers in Canada have also done very well financially in their businesses being protected from outside competition.

However Canadian dairy farmers have a supply management system that protects them from outside competition and provides cost-plus pricing. They are not cost leaders and have not invested in processing and marketing. As a result there are significant differences between the New Zealand and Canadian dairy sectors in term of average farm size, cost, production efficiencies and prices paid to dairy farmers for their produce.

The growing importance of marginal and small farmers to the economy is manifold. On the other hand these kind of people depend upon agriculture and dairying basically to make their living. As dairying is saviour of these farmers - constraints inhibiting their growth should be removed through policy interventions. There is a need to revamp the fodder production, breeding programme and credit policy so that the marginal and small category farmers could be benefited out of these (P. Kaur, A. S. Bhullar, M. Singh, & I. Kaur, 2008).

Today the scarcity of feed and fodder is found to be a major barrier in the dairy farming. The shrinking of land and green pastures are some of the serious problems which are in turn responsible for the green and dry fodder shortages. UNFAO (2008) cites that the rising international cereal prices are aggravating the food inflation in many parts of the world. The report reveals that the cultivation of commercial crops at the cost of food grains, rising transportation costs and longer trade routes are some of the major causes in the increase of the cereal prices. This is also the reason for the high feed and fodder prices across the world resulting in increased cost of animal production and livestock prices. For an instance the Indian scenario of fodder shortages is being depicted in the table 2.2.

Table 2.2: Green and dry fodder shortages in India (million tonnes)

Year	Demand		Supply		Deficit as percentage of demand	
	Green	Dry	Green	Dry	Green	Dry
1995	947	526	379.3	421	59.95 (568)	19.95 (105)
2000	988	549	384.5	428	61.10 (604)	21.93 (121)
2005	1,025	569	389.9	443	61.96 (635)	22.08 (126)
2010	1,061	589	395.2	451	62.76 (666)	23.46 (138)
2015	1,097	609	400.6	466	63.50 (696)	23.56 (143)
2020	1,134	630	405.9	473	64.21 (728)	24.81 (157)
2025	1,170	650	411.3	488	64.87 (759)	24.92 (162)

Source: Planning Commission, GOI (2001)

As per the figures depicted in the table 2.2, there is a serious shortage observed in case of green fodders amounting to more than 60 percent whilst the dry fodder production can't cater to the need of around 20 percent demand. It is clear that dry fodder problems can be sorted out but there is a great question mark on the green fodder since the shrinking of land due to sky-scrapping infrastructure and commercial crop cultivation instead of the regular crops like paddy, wheat, sugarcane etc. The planning commission has predicted that the shortage will amount to 65 percent by 2020 and will seriously affect the dairy farming in India.

Shortage of feed and fodder has become one of the major threats in dairy farming. As per the statements of some of the dairy farmers from the district of Chittoor (usually said to be milk-bowl of Andhra Pradesh with one million cattle producing 1.5 million litres of milk per day approximately), the profession is profitable if the cow produces 8 to 10 litre of milk per day. The Chittoor district which comes next to Anand (Gujarat) in dairy farming is also one of the major milk suppliers to the entire south in India. The cost of feed and fodder is increasing by leaps and bounds becoming an unaffordable factor for the rural milk producers. These together with the shortage of fodder supply from the government are becoming fiercer day by day making the profession extremely difficult to practice. Due to the increasing burden of this dairy farmers from the districts are selling off their cattle to the slaughter houses (Times of India, The 22nd April 2010) and getting rid of the business at the end.

2.4.1 Cooperative based dairying

Cooperative based dairying play a major role in the dairy sector of a country. The sector aims at strengthening the milk producers in the rural areas by marketing their produce in a fair price. Regarding the industry views of some of the practitioners and great quotation are mentioned below.

> "In cooperatives men and women have in their hands the tools to fashion their own destiny." Murray D Lincoln

A cooperative is an association of persons usually of limited means, who have voluntarily joined together to achieve a common end through the formation of a democratically controlled business organisation, making equitable contribution to the capital required and accepting a fair share of risks and benefits of the undertaking (International Labour Organisation as said in Ramkishen, 2003, p.5) where:

- The ownership and control of the enterprise must be in the hands of those who utilise its services
- Business operations are conducted on a cost basis (profit goes to members)
- The return on investors' capital shall be limited.

There are varieties of cooperatives organised as per the requirement of its members. They are namely marketing, purchasing, service and processing cooperatives. The processing cooperatives are the modern kind where the raw material like milk is processed and sent to the market for selling directly. The rationale behind the cooperative based marketing is to eradicate the middlemen and securing the larger share of price paid by the end user for the final products (FAO, 1955). They are also termed as new generation cooperatives (NGC). This move further empowers the farmers to specialise in the downstream marketing channel and adds value to their products. Today most of the cooperatives are becoming sick due to lack of sufficient capital, inadequate membership support and ineffective management (Kohl & UHL, 2002). The cooperatives are based on seven major principles as stated hereunder:

- Voluntary and open memberships
- Democratic member control
- Member economic participation

- Autonomy and independence
- Education, training and information
- Cooperation among cooperatives
- Concern for community

Dairy cooperatives which have started their beginning way back in 18^{th} century in USA play a major role in procurement, processing and marketing of milk and represent farmers at both state and national level. In contrast to the 15 percent of organised milk market in India, 226 dairy cooperatives with 298 production plants in USA, market almost 83 percent of the total milk production out of which 61 percent is sold as raw whole milk (Richardson, Adams, DeVille, Penn, & Kraenzle, 1998). In USA, 80 percent of the dairy farmers belong to the dairy marketing cooperatives and 98 percent of the milk produced enters the commercial marketing channels as whole milk.

In contrast to USA milk market Karmakar and Banerjee (2006) have revealed that the cooperative milk processors have 60 percent market share in India wherein 90 percent of the milk collected is processed for liquid milk packaging unlike the private dairies. The private dairies focus more on the value based products and sell only 20-40 percent of the procured milk in liquid form after processing and the rest is processed to make various dairy products (Kohl et al., 2002; Karmakar & Banerjee, 2006).

There are so many advantages of the participation in the cooperative societies. Jithendra Kumar and Shankara Murthy (1992) have found that income earned is more by members of the cooperative societies compared to the non-members and the number of employment days created is also substantially more for the members than the non-members. Hence they have concluded that the dairy cooperative societies contribute significantly in generating more income and employment to the dairy farmers.

Self Help Groups (SHGs) work at par with the dairy cooperative societies and hence can be inter-linked to improve the condition of each other. Das and Malik (2005) have highlighted the formation of SHGs and their role in the dairy farming. As per their study in the district of Karnal, 63 percent of SHGs have opted for the dairy indicating favourable attitude towards the enterprise. This is due to the reason that dairy husbandry is a traditional occupation for the marginal and landless farmers and hence can be practiced in a big way at their level.

Thirunavukkarasu and Sudeepkumar (2006) have conducted a survey on milk producers who are tested with 12 major socio-economic and socio-psychological variables under Salem - Namakkal district cooperative milk union of Tamil Nadu. According to them the milk producers in the cooperatives and integrated contract system have higher education level, better land holdings, higher investment, larger herd size, better dairy income, credit behaviour, extension agency contact, mass media exposure and economic motivation. But in case of dairy farming experience they have found that the milk producers from cooperative sector are lagging behind comparing to the vendor and integrated systems milk producers. The level of aspiration for making dairying as a livelihood and occupation is quite similar in all cases. Interestingly almost 95 percent of the milk producers from each category reveal dairying as their subsidiary occupation. Since the study highlights the organised sectoral benefits the authors have cited that efforts should be made to attract more and more milk producers from unorganised sector.

Rajgopal (1996) has cited that the procurement pricing in case of the private dairies is 18.37 percent more than the cooperatives based dairies. On the contrary, the cooperatives offer better services to the milk producers. His survey has also shown that retailers prefer more to sell the products of the private dairies rather than the cooperatives based dairies for many reasons. The reasons are basically for guaranteed supply of milk, higher margin and credit facility to name a few. He also has highlighted some of the core problem areas of the cooperative based dairies like:

- Inadequate milk supply
- Low commission
- Regulated pricing
- Long product line
- Weak promotion
- No credit facility etc.

To add to the above arguments Rao and Sharma (2003) have stated various problems faced by the milk producers, cooperative societies and consumers. Their empirical study by them reveals that about 30 percent milk producers do not get their payment on time which brings resentment among the milk producers who solely depend upon the cooperative societies for selling off their produce. About 70 percent of the milk producers have expressed their unhappiness on the incorrect measurement of milk by the secretaries of the respective cooperatives and 45 percent of them demand that the pricing should be based only on the fat content of the milk rather than both fat and Solid-Not-Fat (SNF) content.

On the contrary, about 60 percent of the secretaries have shown their discontentment on the measurement of milk at the plant level. On the distribution side - processing plants are facing difficulty from the frequent power cuts, improper transportation mode and outdated machineries. Further more than half of the consumers are dissatisfied on the quality of the milk with respect to its price. These are not usually found in case of the private dairies which have got an edge over the cooperative based dairies. There should be a definite policy for procurement of milk in both flush and lean seasons to sustain dairy cooperative societies and its members. Local sale of the milk at the cooperative level should be encouraged to enhance the brand image of the federation especially in the rural areas (Sharma, Saxena, Mahato, & Das, 2007).

Karki (2005) in his study has revealed about some of the major impediments in the cooperative based dairy industry and differentiated the strategic planning of the corresponding industry in developed and developing countries. According to him the developed countries consider the dairy cooperatives as the source of sustainable business and the developing countries like India perceive it as a source of income. Keeping view to the income of the cooperative societies the government of India is might impose income tax on them which might deteriorate their financial status (Ghanekar, 2008).

The cooperative societies should not be treated as other profit making organisations because they distribute surplus earning to their members. Moreover Ghanekar (2008) has cited that the objective of the income tax is to ensure equitable distribution of wealth and facilitating the government to undertake various public welfare programmes. In the similar way, the sole priority of the cooperatives is to upgrade the status of their members (farmers) without any profit making attitude. He also insists for the removal of government control over the cooperatives making them more autonomous in fixing the price and deciding over other major issues.

Dixit (2008) has revealed that Indian dairy industry is enriched not because of the cooperative and government dairies only rather it is the private dairies who contribute to almost 59.43 percent of the total milk processing in the country hence the governments both at the state and central level should take care of the private dairies which will further blossom the industry in many ways, he has urged.

Khanna (2003) has highlighted about the use of EIAS (Enterprise-wide Integrated Application System) in the cooperative dairy sector which is based on the ERP software solutions. According to him the software can integrate all the functions ranging from the procurement of the raw materials to the distribution of final product to the end user. It reduces inventory up to 25 percent, eliminates wastages at all level of the supply chain, cuts down the manufacturing lead times and improved availability of the quality product to the end users. He also has mentioned about the usefulness of Artificial Intelligence (AI) in the dairy industry in decision making.

With the advancement of technology there is a tremendous growth felt in almost all sphere of life. The invention of automating milk collection machines has brought significant changes in the collection of milk at the dairy cooperative societies by increasing their efficiency. Not only this, it has provided scope for accessing the past record relating to milk collection to plan better and improve the yield and quality of milk so collected. These in turn will be handy for the competitiveness of the Indian dairy industry as a whole. This together with the help of internet help farmers improve their productivity and gain better access to government services (Sharma & Yadav, 2003).

Sarkar and Singh (2006) have highlighted applications of Business process Re-engineering (BPR) in cooperative sector. They have mentioned that the re-engineering may not always guarantee success in the organisation unless until it is backed by strong information and communication technology (ICT).

2.5 Supply Chain Issues in Dairy Industry

The supply chain is based on the three major premises namely cost, quality and time (Monczka et al., 2002). While minimising cost and maximise profitability throughout the supply chain are key issues to see that every stakeholder is satisfied; meeting the demand (with quality products and on time delivery) without any breaks is also extremely important for it (Chopra & Meindl, 2003; Shapiro, 2001). The total cost may include all direct and indirect costs so that the merchandise is produced and delivered to the end users at right time right place (Simchi-Levi et al., 2008). Purchasing-, production- and distribution related costs play major role in the total cost calculation of a supply chain.

2.5.1 Cost and factors of milk production

According to Sharma et al. (2007) the fodder costs are the highest among all the factors of milk production (70 percent). The factors which affect the cost of milk production are:

- Milk yield per animal
- Feeding policy (pasturing vs. dry fodder feeding)
- Fodders and concentrates
- Herd size
- Health and medicine
- Labour expenses
- Management factors (care and supervision)

Saravanakumar and Jain (2008) have revealed that, the cost of milk production and gross cost increase with the increase in the herd size but the reverse result is found in-case of income. The small farmers are able to earn more profits comparing to the large farmers. The small farmers depend more upon the green pasturing since they are unable to afford to dry fodders available in the market for their cattle and hence their cost of milk production is lesser than the large farmers.

Barman, Konwar and Kumar (2008) have revealed the strategies for optimum production of milk at the farmer level. They have illustrated the benefits of proper feed management, use of supplement fat and protein in the regular diet of the reared animals. They have also cited about the various constraints of administering fat, protein and Non-Fibre Carbohydrate (NFC) in the diet of the cattle. According to them high producing dairy cows should eat 3.6 to 4.0 percent of dry matter corresponding to their body weight, protein should be within the range of 18-20 percent and NFC should range between 30-40 percent and fat level should not exceed five percent in the regular ration. They suggest that maintaining of good records is important in dairy farming which later on might provide evidence of a potential problem.

Measuring the cost of milk production is usually not possible at the milk producers' level and thus can be known with the help of three methods namely survey, direct observation and formula. Regression equation can be developed from the study and later can be used as a formula to find the cost of milk production. The total cost is calculated on the basis of the investment made on the fixed assets and variable cost per month or annum. While calculating the cost of the fixed assets depreciation is brought under the purview of cost of milk production. The depreciations on cattle and infrastructure (building and equipments) are based on seven years and 50 years of life span respectively (ICAR, 2002; Prasad, 2005).

Sharma et al. (2007) have found that the cost of milk production is Rs.10.75 per litre while making their study in Uttaranchal region of Uttarakhand state. Saravanakumar and Jain (2008) have conducted their study in Tamil Nadu for calculating the cost of milk production in both lean and flush seasons. According to them the cost of milk per litre in flush and lean seasons are respectively Rs.7.59 and Rs.8.03. According to Prasad (2005) the average cost of milk production is found to be Rs.8.27/lt under some specific conditions. He has also cited that the costs incurred on the crossbred cows are more than that of indigenous cows and buffaloes. The cost of production also varies with the urban and rural conditions of cattle rearing. Due to higher Total Milk Solids (TMS) buffaloes are more preferred to cows (Khanna, 2008) and hence 55 percent of the milk produced in the country comes from the buffaloes (Ministry of Agriculture, GOI, 2005-06).

2.5.2 Procurement and chilling

Banerjee (2008) highlights about the country's export capabilities of the dairy products. He expresses that now-a-days around 45 percent of the total milk produced in the country remains still with their producers because of the high transaction costs. He also emphasises upon the proper storage support system of the produce to address the demand-supply complications.

According to Kohl et al. (2002) the farm price of milk is influenced by the following factors. They also state that the elasticity of demand is lower for fluid products than that of processed dairy products

- The cost of production
- Domestic supply
- Consumer demand
- Government policy
- Federal and state milk marketing orders

- Dairy farmer cooperatives
- Import and export policies

Ashok Kumar and Sayulu (2007) in their study of procurement and processing practices of Karimnagar dairy reveal that the dairy has been paying Rs.12.50 per litre for buffalo milk and Rs.8.75 per litre of cow milk with a combined average price of Rs.10.07 per litre (for a combination of 70:30 milk of buffalo and cow). According to them the dairy assigns 70 percent of surplus as bonus, deposits three percent for cooperative development and allocates 10 percent to village welfare activities and 17 percent to cattle development programmes.

As long as the procurement and processing are concerned there is a rise of transportation charges with a decline in the overhead costs during the study period of 2002-2004. The transportation charges increase from 0.56 paisa in 2002-2003 to 0.62 paisa in 2003-2004 per litre of milk which could be attributed to lack of logistics planning. At the same time the overhead costs decrease from Rs.2.58 in 2002-2003 to Rs.1.98 in 2003-2004 per litre of milk. They conclude by saying that the milk transportation routes must be rearranged and milk collection centres should be provided with storage facilities to reduce the cost of procurement.

Efficient milk procurement could minimise the cost of procurement, chilling and processing. Rangasamy and Dhaka (2007) have compared the cost of milk procurement by cooperative and private dairy plants in Coimbatore district of Tamil Nadu. The cost of collections at the collection centres of cooperative based dairy and private dairy have been found to be respectively Rs.0.37 and Rs.0.38 per litre – depicting a similar trend. The cost of collection much depends upon the level of milk collection – if the collection is higher than the cost of collection comes lower and vice versa. Basically in the lean seasons there is a severe fluctuation in the milk production and hence the procurement at the collection centres gets badly affected. This brings up the processing costs of other downstream members.

In both the cases the respective figures for the procurement and transportation are found to be Rs.0.39 and Rs.0.61 per litre. It may be noted here that the private dairy plant's supply chain is slightly different from the cooperative based dairy. The private dairy plants directly source from the collection centres whereas the later procures it from the chilling centres – the next stage of societies. Clearly the longer is the chain the higher is the cost of transportation and processing (Ashok Kumar et al., 2007).

The average costs of chilling at the cooperative based dairy and private dairy plants are found to be respectively Rs.0.31 and Rs.0.32 per litre. The costs of reception are detected to be Rs.0.18 and Rs.0.12 per litre respectively at the cooperative and private dairy plants. The cost of procurement for the cooperative based dairy plant varies from Rs.1.38 to Rs.1.55 per litre depending upon the variations in the level of collection. The respective figures for the private dairies are found to be Rs. 1.33 to Rs. 1.45 per litre. The situation in the cooperative based dairying can improve further if there would be regular payments to the milk producers in the rural areas (Rangasamy et al., 2007).

2.5.3 Production and distribution

The increasing supply chain costs are compelling the organisations to increase either the prices of the product or to negotiate with the suppliers to lower down their prices. But in both the cases two end points of the supply chain get hampered which might lead to lesser procurement or lower market share due to non-competitive prices of the product. The higher processing cost is attributed to the lower procurement and in turn is a result of lower participation of the suppliers (milk producers) in the organised supply chain.

Agrawala (2003) has stressed upon the adoption of new equipments for producing milk products. Presently the equipments used in the factories are poor in hygienic design, inefficient in energy use and labour intensive. He has highlighted that in order to overcome the inherent disadvantages versatile equipments should be developed which can manufacture more than one product with varying degrees of quality. Moreover since milk needs utmost care for processing - attempts should be taken to fabricate equipments which can be fully cleaned and conform to the hygienic standards.

Rangasamy and Dhaka (2008) have compared the costs of production and marketing for the cooperative based and private dairy plants in the Coimbatore district of Tamil Nadu. They have considered several products like toned milk, flavoured milk, butter, ghee etc. and tried to find out comparative costs on these items being expended by the plants. In most of the products the total costs incurred are more in case of the cooperative based plant than that of the private plant. In the similar way the market efficiency of the private plant is found to be higher in almost all the products except toned milk where the efficiency of the same is 0.08 as against 0.17 of the cooperative based plant. The marketing efficiency is nothing but the ratio of margin and total marketing cost of the particular product. Though both the plants have been found to be not very competitive in the market still the private dairy plant is performing at a higher level than the cooperative based plant.

Once the product is produced for being offered it is priced depending upon various situations. The pricing strategies could be cost-plus, competitive or psychological etc but due attention should be given to the quality and price match (Teng & Jaramillo, 2005). Kotler (2000) proposes five major pricing objectives where he has revealed that before setting price the firms should assess themselves on the basis of their offerings. The following objectives are therefore highly dependent upon the market positioning strategy of the firm:

- Survival
- Maximum current profit
- Maximum market share (penetration pricing)
- Maximum market skimming
- Product-quality leadership

Business Standards (2010) in its report says that, the demand of the milk is rising much faster than the production and in order to fulfil the demand it is essential that the production should increase by another five million tonnes of milk per annum. It has been predicted that during 2021-2022 the demand of milk will be around 180 million tonnes per annum which is almost double of today's production. In order to fulfil the gap it is essential that all the stakeholders in the system should work hard and strive for excellence. The Chairman of the board (Amrita Patel, at 38th dairy industry conference, Bangalore) has reiterated the same and focused on the domestic production rather than sourcing from other countries. In this way the millions of the livelihood in the sector could be preserved and demand-supply gaps could be minimised. According to the report the share of marketable surplus of milk both in the private and cooperative sector should be increased from 30 percent to 65 percent in the organised sector to fulfil these requirements.

Natraj (2005) has described the 3 A's of milk marketing – Availability, Acceptability and Affordability. He rightly points out that even if milk is available and being accepted by the people, it is not affordable by the poor people in the country. He has suggested the companies to sell the products in the economy packs to make it reach the down trodden.

Vaswani (2008) has cited that milk and milk products account for a significant 17 percent of total household expenditure on food. He mentions about the various business models for selling of the traditional milk products. According to him though B2C and B2B are the basic models used by the organisations still there is a huge scope for the franchising and online business models for making business on traditional milk products.

Rathinam (2008) has described about the challenges and opportunities in super market retailing of dairy products. Depending upon the requirement of the consumers he has classified them into four different categories namely - unattractive, attractive, attentive and potential. Unattractive customers are those who produce and consume milk themselves whereas attractive consumers purchase dairy products mostly from the unorganised sector.

Attentive consumers purchase only from the organised sector which gives quality products. Potential consumers who want to consume milk and allied products but do not come under any of the above categories. By mentioning this he precisely focuses on pulling the consumers towards the organised sector through retail stores and super markets. Currently the organised retail market is valued at Rs.350,000 million as against the total market size of Rs.9,900,360 million representing only 3.5 percent of which the food and grocery organised sector is represented by only 0.6 percent.

2.5.4 Quality and safety issues

Now-a -days there is an increased tendency found for the quality of the product and production process. This is due to the increased level of consumer awareness and stringent government regulations for food products. The situation is tighter when it comes to the perishable products like milk and meat. The illness arising out of consumption of damaged products could be extremely fatal and might lead to loss of life. Hence the stringent quality check of the product has essentially become a part production process. There are different concepts followed in various organisations to control the quality of the product and production processes namely; Good X Practice codes (GXP), International Standardisation Organisation systems (ISO-9000), Hazard Analysis and Critical Control Points (HACCP) and Total Quality Management (TQM). The differences among ISO, GXP and HACCP are mentioned in the following table where TQM is the most comprehensive way of maintaining quality in the organisation across the board and some way or the other covers all the principles of the later ones.

Table 2.3: Distinctions among various quality standards

Feature	ISO	GXP	HACCP
Bottom-up approach	No	No	Yes
Orientation	Process	Product	Process/Product
Health demonstrable	Yes	No	Yes
Fit for true certification	Yes	No	Yes
Documentation needed	Very much	Much	Little
Self-management	No	No	Yes
Farm-specific	No	No	Yes
Labour-intensive	Yes	No	No
Many people involved	Yes	No	No

Source: Noordhuizen (2003)

It can be seen from the table that, a product like milk is more of farm-specific where the quality can be controlled in an effective way. The farm-gate milk quality is essentially an impact of cattle health, harvesting and storing conditions, feeding process. In this case the role of a milk producer is highly crucial because he/she is the person who rears dairy herds and sells milk to the cooperatives or to the open market. Hence the consciousness among the milk producers should be of paramount importance about the HACCP rules. This can be practiced in the following ways at the farm level to upgrade the quality and safety of milk:

1. Conduct a hazard analysis: identifying the areas where hazards occur like physical or chemical change of the material (e.g. curdling or damaging);
2. Identify the critical control points: the step at which the damage can be prevented for which temperature, time and procedural issues can be considered;
3. Establish critical limits: establishing criteria for each critical point (e.g. till how long milk can be preserved without chilling);
4. Establish monitoring procedures: the process should be monitored and records should be kept for future use;

5. Establish the corrective actions: the corrective actions should be taken in proper way to ensure that no damaged material (product) is released from the farm and
6. Establish verification procedures: there should be proper mechanism to be followed to oversee that the controls are working as per the planning.

Some of the HACCP criteria may not be understood at the milk producer level and hence can be eradicated by proper training and education. The milk producers are the only source of supply to the organised dairy chain and hence the quality and safety of the product can be mostly controlled by them while producing the same. Once this is practiced throughout the entire supply chain this can be maintained without flaws which will help it to perform better.

Khanna (2005) expresses his concern over the HACCP and Codex principles so as to recognize Asian products in the global market. The rising awareness about the hygienic standards and adulteration of milk has led consumers in the urban areas to consume pasteurised milk which might increase the demand for milk and milk products from 155 million MT in 1998 to 567 million MT in 2025.

Karmakar and Banerjee (2006) have highlighted various aspects of the Indian dairy industry. According to them cost of production, infrastructure, provisions for sanitation etc. need to be developed. They also stress upon the ISO and HACCP certifications for the dairy plants. Manufacturing of eco-friendly products also these days are getting attention due to the increased pressure from the government and other regulatory authorities. The customers are getting aware in this regard and hence the impact of eco-friendly food products on the long term relationship with customers can't be overlooked. It has been seen that while purchasing a food product consumers in India mostly give priority to the qualitative, recyclable, refillable and eco-friendly products. Hence in addition to the ISO, HACCP and other best manufacturing practices it is also essential to look into the manufacturing of eco-friendly products (Deb, Mishra, Guin, & Sinha, 2007).

Sohrab (2008) highlights some basic issues of quality and safety for the Indian dairy industry. According to him an estimate of the World Health Organisation (WHO) every year there have been 1.5 billion food borne illnesses caused out of which 3 million death cases recorded. In order to deal with such difficulties and to make Indian dairy industry competitive in the global market he has urged for the involvement of the top level management in the sector. He further has emphasised on training and education of the personnel in Hazard Analysis and Critical Control Points (HACCP) principles in the organisation and mentioned that ISO 22003 criteria should also be applied to the consultants who basically certify the industries on various quality aspects to make the system more transparent.

2.6 Supply Chain Risk

A famous quote by the Greek Historian "Herodotus" depicts that, "Great deeds are usually wrought at great risks." So in order to improve the overall supply chain value, it's highly needed to tackle risks and uncertainties with a suitable strategy. Of late, supply chain risk management has gained attention throughout the world. Identifying potential supply chain risks and unearthing a suitable strategy to mitigate them have been found to be the key success factor irrespective of the nature of the organisation. Though not much of work is done in this context still some of the empirical works published by various theoreticians and practitioners will give direction for others to opt for the critical issues and a prospective solution thereto in the supply chain. So there is a need for research to fortify the concept (Thun & Hoenig, 2009; Juha & Pentti, 2008).

In this research one of the important objectives has been to detect the potential risks for the dairy-food supply chain and a strategy for risk mitigation. Risk management is a proactive approach rather than reactive approach (Gray & Larson, 2008). The risk management process starts with identification of the risks and ends with the risk mitigation through the risk response development. Risk mitigation, avoidance, transferring, sharing and retaining are various strategies undertaken to deal with the risks in the organisation.

The risks involved in the supply could impede the flow of the supply chain. Zsidisin (2003) has suggested a grounded definition of risk after having an in-depth case study research. According to him:

> "Supply risk is defined as the probability of an incident associated with inbound supply from individual supplier failures or the supply market occurring, in which its outcomes result in the inability of the purchasing firm to meet customer demand or cause threats to customer life and safety." (p. 222)

He has further opined that the supply risk depends on the risk sources and outcomes whereas understanding the risk sources differs from industry to industry. Supply chain risks are increasingly rampant in the globalised era. All decision makers of the supply chain have to come across this deadlock (Akcaoz, Kizilay, & Ozcatalbas, 2009). Definitions of risk and risk management are multifarious and many have emerged over time (Zsidisin, 2003). The British Standards Institute (BS 4778, 1991) defined, "risk as a combination of probability or frequency of occurrence of a defined hazard and magnitude of the occurrence.''

Risk and uncertainty though used interchangeably in various studies, are not one and the same. Wherever in case of risk the probability is known, it is not known for the uncertainty. But both incur loss to the supply chain (Siegel, 2005). No matter how robust is the supply chain - risks and uncertainties can't be ruled out which requires attention and if unattended will affect the supply chain adversely in many ways (Simchi-Levi et al., 2008).

Supply chain in any industry is entangled with many stakeholders and so is supply chain risk. The risks and uncertainties in the supply chain earlier were dealt with as a company specific task (Juttner, 2005). It is today realised that since the supply chain is a complex bonding of several stakeholders, distortion at one of the components distorts the entire chain by varying degrees. Supply chain risk management is at infancy stage and gradually becoming a popular research area day by day.

Vanany, Zailani and Pujawan (2009) reviewed 82 relevant articles pertaining to supply chain risk management from several established journals and data bases from the year 2000 to 2007. They have segregated these papers on the basis of type of risk, unit of analysis, industry sectors and risk management processes/strategies. Understanding, identifying and assessing the risks based on probability of occurrence and severity of impact is a starting point for companies to develop effective risk management strategies. Certain terms are used in the risk management process very frequently (Sadgrove, 2005):

- Hazard: a source of potential harm
- Risk: the possibility that a hazard will cause damage
- Risk assessment: evaluating risks in terms of impact
- Risk management: a discipline of dealing with uncertainty

Supply chain vulnerability is a threat to the entire supply chain network which disrupts it in many ways. The vulnerabilities in the supply chain can be experienced in many ways. According to Alder (2007) in terms of business risks they are namely:

- Commercial risks (price contracts with the suppliers)
- Process (supply-demand match)
- Operational (shortage of materials)
- Strategic (not understanding the market properly)
- Financial (insufficient funding)
- Knowledge management (lack of key knowledge)
- Contractual (exposure to liquidated damages)
- Reputation (brand damage)
- Compliance (stock exchange rules)
- Environmental (natural disasters)
- Employee risk management (insufficient staff)
- Political and economic instability (EXIM policy etc.)
- Health and safety risks

To add to the above risk factors human related flaws and vulnerabilities too play a crucial role in the entire supply chain. Operational losses that incur through inadequate staffing for required activities are commonly termed as human risks. These may be due to the lack of training, poor working culture, loss of key employees, bad management and so on. Some operational risk score data on human risks might be available, such as expenditure on employee training, staff turnover rates, number of complaints and so on. But human risk remains one of the most difficult operational risks to quantify because the only information available on many of the important attributes will be subjective beliefs. There seems to have a crucial role of the suppliers in the whole supply chain. The suppliers' risk coping efficiency is one of the major antecedents for it. The problems pertaining to financial instability, capacity constraints, quality related risks and the technological changes are the major variables found disrupting the suppliers' stand in the supply chain (Zsidisin & Ritchie, 2008).

Procurement is one of the key activities of the supply chain management. It has been seen that the organisation's 60 percent of the sales income is invested for the procurement of material (Tiersten, 1989). Procurement related risks are oftentimes perceived differently by the industry people. Whereas the high-tech organisations follow the informal and decentralised process in the risk management, the traditional manufacturing organisations are leaned towards the centralised and formal process (Juha & Pentti, 2008). The qualitative study by Juha et al. (2008) on eight traditional manufacturing companies and seven high-tech companies in Finland reveals the results. They have suggested that "perceived risk of a buying task can be most efficiently managed by changing dynamically buying centre structure to different buying situations and during the buying process". Companies should utilise their internal networks more efficiently as well to manage the purchase-related risks, they highlight in their study.

Schoenherr, Tummala and Harrison (2008) have highlighted the risk issues pertaining to the off-shoring decisions in the supply chain. This decision in the production process might give rise to poor quality, higher transportation costs, lower reliability, supply disruptions, logistical failures, natural disasters and increased communication difficulties etc. In order to find the best solution for this they have undergone through the Action Research method with the help of Analytic Hierarchy Process (AHP). They have identified 17 risk factors and then used AHP to evaluate the importance of each risk factor and to determine the best alternative. According to them product cost and quality are highest vulnerable areas associated with the off-shoring decisions putting natural disasters and engineering and innovation as the least concerned areas in it.

Thun and Hoenig have conducted a survey of 67 manufacturing plants in German automotive industry for investigating the vulnerabilities of supply chains. They have found that supply chain risks are predominantly vulnerable wherein globalisation, product variant, supplier reduction and the outsourcing are some of the key drivers which disrupt the chain. According to them the internal supply chain risks are more likely to occur and affect the supply chain performance more adversely which has taken to be one the hypotheses of this research. Their study says companies with higher degree of supply chain risk management perform better than others who perform at a lower level of it.

Furthermore the results show that the group using reactive supply chain risk management has higher average value in terms of disruptions resilience or the reduction of the bullwhip effect whereas the group pursuing preventive supply chain risk management has better values concerning flexibility or safety stocks.

Managing supply chain risks has become one of the major concerns in the value chain. Though the severity of the risks get realised in varying degrees across the supply chains, organisations perceive the risks in different ways. Some are risk takers whereas some are risk avoiders who want to be at the safe side. No matter what a company's attitude is in risk management, there is a little bit of impact realised throughout the chain. To know about how companies react to the risks, the Economist Intelligence Unit surveyed 500 executives from various companies across Asia-Pacific, North America and Europe. According to the report 62 percent of the respondents opine demand unpredictability as one of the major disrupting force in the supply chain. More than one-half of all respondents have been hit by the rising input costs and volatility in energy prices and over one-third has been affected by the insolvency of partners or suppliers. Furthermore one-half of the respondents opine for improving the collaborations with the partners or suppliers as the major weapon to combat supply chain risks.

2.6.1 Supply chain risks in agriculture

Vithal (1986) has highlighted some major factors that affect the smooth functioning of the dairy cooperatives. According to him factions among the villages, caste dominance, practice of proxy, menace of local vendors and lack of professionalism among the staff etc. are some of the basic issues which retard the day-to-day activities of the cooperative societies. All these factors can be treated as the risk areas for the dairy cooperative societies which operate in the rural areas. Ashok Kumar et al. (2007) and Kaur et al. (2008) have raised some of the major problem areas – among those some of them are:

- Inadequate supply of feed and fodder
- Sudden changes in seasons
- Unsuitable location for milk collections etc.

The asymmetric information between the suppliers and the manufacturer could lead to supply chain disruption and finally lead to market failure. The study by Gorton, Dumitrashko and White (2006) in Moldova has tried to look into the issue. The authors with the help of a dairy case have suggested that rebuilding relationships, contracting and strengthening of the village collection centres could ease the problems.

Ramaswami, Ravi and Chopra (2004) have defined the agricultural related risks what an Indian farmer usually face these days. The major threats, the Indian farmers are facing today are declining size of the land holding, degradation of soil and water resources, inadequate institutional credit support and lack of opportunities for non-farm employment etc., they have cited in their book on State of the Indian farmer: Risk management. According to them there are basically two types of risk at the farm level - agricultural risk and non-agricultural risk.

Production risk (weather, pest and diseases), price risk (lack of demand) and input risk (shortage of inputs or when their prices vary) are the risks come under the agricultural risks. There are certain risks which are common to all are called as systematic (covariate) risks and risks specifically related to a particular farmer are termed as idiosyncratic risks. Risk management and mitigation can be done at the farmer level or at the community level as a whole. This can be done either with the help of self-insurances for the crops or risk pooling and mutual insurance at the community level - they have added to their work as a method of risk management strategy.

Ali and Kapoor (2008) have discussed about various types of risks for the fruits and vegetables. Investment, socio-economic, environmental, production and market risks are the major perceived risks in the production of fruits and vegetables. Price and production risks are the most vital risks in this case - they have mentioned. Better risk management in this can be done through the improved information technology, development of financial markets and promotion of market based price ensuring marginal farmers to get benefit out of it.

Akcaoz et al. (2009) have conducted a survey of dairy farmers in the Antalya province of Turkey in order to know the risk management strategies in the farms. In all the farms irrespective of their size - milk price variations, lack of hygienic conditions and the meat price variability have been found to be three major risk sources keeping aside the marketing problems. They have also identified that keeping the debt low, producing at the lowest cost possible and good liquidity conditions are the key risk management strategies followed there.

2.7 Supply Chain Coordination

Malone and Crowston (1994) reveal that, "coordination is an act of managing dependencies between entities and joint effort of entities working together towards mutually defined goals". Instead of setting up of objectives at different levels of the supply chain it is better to have a common defined goal. This will not only eradicate the differences among the channel partners rather help achieve the desired goal by maximising the return at all levels of it. On the other hand collaboration is defined as, "the process by which two or more parties adopt a high level of purposeful cooperation to maintain a trading relationship over time." Both parties have equal power to shape its nature and future direction over time. The firms should have limited number of suppliers so that the proper buyer-supplier relationship can be maintained in the long run (Monczka et al., 2002).

Coordinating the various activities of the supply chain is one of the complex phenomena. The supply chain which constitutes of several stakeholders in the system has conflicting objectives and that's why a proper coordination mechanism is the need of the day in order to have overall profit maximisation. According to Ramdas and Spekman (2000) lack of coordination might result in low performance affected by inaccurate forecast, low capacity utilisation, excessive inventory, inadequate customer service, extended lead times, low customer satisfaction etc.

Simatupang and Sridharan (2002) define collaboration as, "two or more chain members working together to create a competitive advantage through sharing information, making joint decisions and sharing benefits (Pyke et al., 2000) which result from greater profitability of satisfying end customer needs than acting alone". Simatupang et al. (2002) have identified six key issues in collaboration namely:

- Setting up of joint objectives
- Integration of decision rules
- Using appropriate measure of performance
- Creation of coherent decision domains
- Information sharing
- Use of appropriate incentive system

The supply chain coordination aims at increasing the total supply chain profits and maximizing end user satisfaction. The lack of proper supply chain coordination leads to bullwhip effect (Lee et al., 1997). This occurs because of the conflicting objectives and individualistic attitude of the stakeholders in maximizing profits. In order to have better control over the supply chain - a proper coordination mechanism is highly essential. It facilitates the inter-firm strategic decision making (Westgren, 1998). The choice of coordination system has a significant impact on whom that has power and control in the supply chain and how risks and rewards are shared. Supply chain incentives and/or penalties used to reward performance and share risk (Boehlje, 1999).

Fitzgerald, McIntosh and Akintoye (2000) describe about the importance of the supply chain collaboration and finds out some of the major drivers of it. The drivers or the driving forces are the ones which are responsible to make desires in the firms to opt for the collaboration in the competitive market place. The major driving forces for the supply chain collaboration are:

- Meeting customers' requirements
- Reducing costs
- Focusing on core competencies
- Intensified competition
- Information/technology boom
- Shorter innovation/product life cycles
- Globalisation etc.

Basmaci (2003) has conducted a survey on supply chain collaboration in Turkey Textile Industry. According to the study, 12 percent of the companies do not make any collaboration with any other company while 56 percent of them collaborate with one to five companies. The rest of them make collaboration with more than five companies. Almost two third of them have responded that the collaboration increases customer satisfaction, productivity and product quality. More than 90 percent of the respondents opine that in order to have successful collaboration - trust on each other, willingness to share information and believing that it leads to mutual benefits, are to be practiced. Most of the respondents opine that lack of confidence, unwillingness to share information, lack of consistent collaboration performance metrics and difficulty in calculating the level of contribution to the collaboration are major barriers to the supply chain collaboration.

Nix, Zacharia, Lusch, Bridges and Thomas (2004) have studied on effective collaborative endeavours in supply chain by focusing on "nature and scope, factors, key drivers and outcomes" of successful collaborations while conducting a survey of 477 companies in USA to reach at a consensus. They have concluded that joint decision making, ideas and information sharing, openness to each other, frequent meetings, higher level of commitment and effective working relationships are the key drivers of a successful collaboration. Some of their major findings are as cited below:

- Firms with strong collaborative capabilities and a commitment to collaborate intensely with supply chain partners can achieve as much as 40 percent improvement in collaboration performance.
- Firms with strong collaborative capabilities and a commitment to collaborate intensely with supply chain partners can achieve as much as 55 percent improvement in relationship quality.
- Firms with the capability to learn from supply chain partners and a commitment to collaborate intensely can achieve as much as 40 percent improvement in collaboration performance.
- Firms with the capability to learn from supply chain partners and a commitment to collaborate intensely can achieve as much as 55 percent improvement in relationship quality.
- Firms with higher levels of problem-specific capabilities and a commitment to collaborate intensely with supply chain partners can achieve as much as 42 percent improvement in collaboration performance.
- Higher level of problem-specific capabilities and a commitment to collaborate intensely with supply chain partners can dramatically enhance relationship quality.

Supply chain integration (Pyke et al., 2000) is one of the crucial areas of the supply chain management. The study made by Van der Vaart and Van Donk (2008) shows the relationship between the supply chain integration and the performance. The review made by them shows that there are significant differences in the factors and the constructs used to measure supply chain integration. In order to measure the same - attitudes, practices, patterns and the inter-relationships items can be considered to avoid more concentration on the firm itself. Furthermore the performance measurement of the supply chain should focus on the buyer-supplier relationships (BSR) by considering the power (inter-dependencies) and business conditions of the focal firm. According to Cookson and Delattre (2001) even though the collaboration raises the degree of complexity and risks in the supply chain still the benefits can be plenty and prepares the background for the optimally coordinated supply chain (figure).

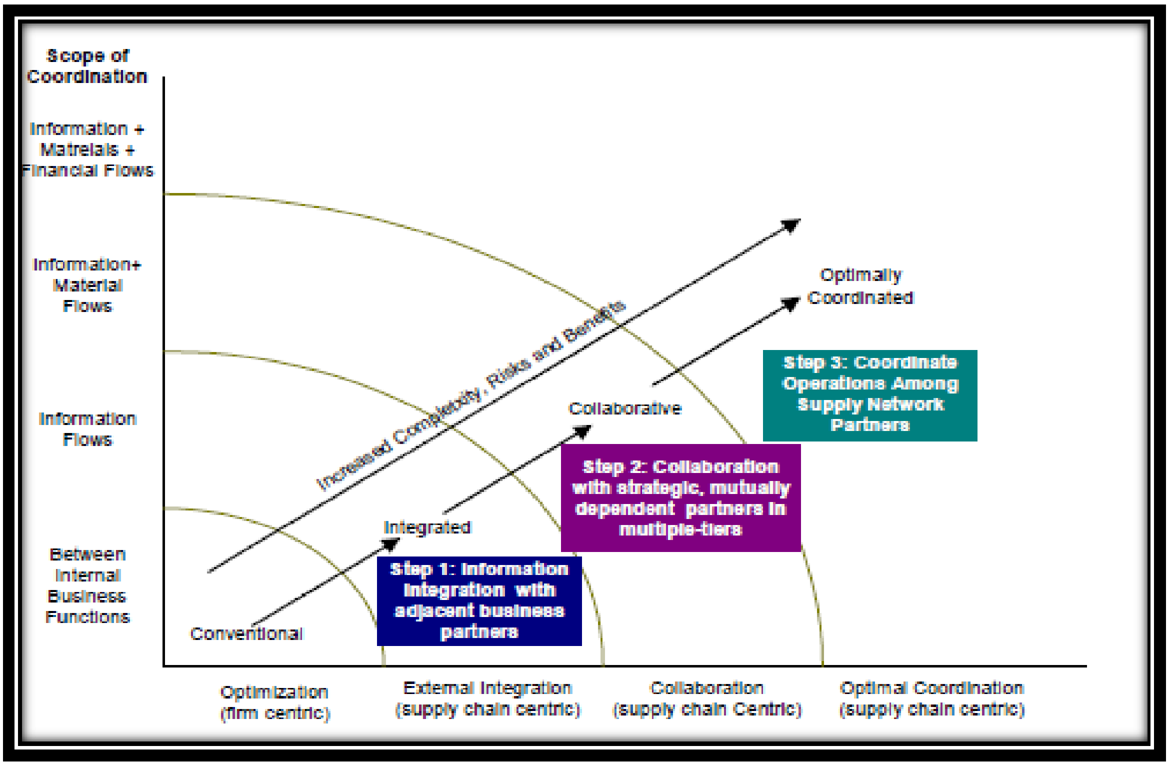


Figure 2.2: Steps in optimally coordinated supply chain

Source: Cookson and Delattre (2001)

Knolmayer, Mertens and Zeier (2002) have discussed some of the contemporary practices of effective supply chain management like Concurrent Engineering (CE) and Simultaneous Engineering (SE), Collaborative Planning, Forecasting and Replenishment (CPFR) and Efficient Consumer Response (ECR) systems. According to them whereas CE is directed towards a distributed realisation of certain development tasks; SE concentrates on developing products and processes in parallel. They also have cited that ECR is a bundle of methods aiming at removing inefficiencies along the value chain stressing upon the joint agreements among all stakeholders to achieve a win-win situations. ECR is a comprehensive management concept based on vertical collaboration in manufacturing and retailing with the objective of an efficient satisfaction of consumer needs. The main components of ECR are supply chain management and category management (Seifert, 2007). The ECR has two basic components namely (i) consumer and (ii) efficient response.

Harrison and Van Hoek, (2005) have defined the ECR and CPFR. Where ECR focuses on meeting the customer demands, CPFR looks after the strategic and operational levels to ensure competitiveness of the supply chain. According to them the efficient customer response system includes category management, continuous replenishment and enabling technologies. The main objective of this two is to improve customer service while decreasing costs in inventory management. Therefore the trade-off between efficiency and effectiveness should be resolved by collaboration in planning and implementation between organisations.

The two basic components are aimed at fulfilling customers' needs and demand efficiently. On supply side, the cooperation in logistics between the manufacturers and retailers are required to make the supply chain a highly responsive one. On the other hand, the demand side collaboration in marketing via category management and exchange of customer data are highly essential.

Souviron and Harrison (2003) have developed a seven dimensional framework of supply relationships with people management aspects. They are:

(i) **Goals:** Each stakeholders should have a specific goal and should be compatible with the aggregate goal of the supply chain;

(ii) **Information sharing:** Two way open and honest information sharing which will strengthen the ties among the partners;

(iii) **Relationship structure:** The firms have to choose from bow-tie or diamond relationship structure. The bow-tie relationship is having a single point of contact and is little narrow in its scope whereas diamond structure has multiple contacts which characterises close relationships;

(iv) **Coordination mechanism:** The coordination mechanism should be flexible and informal aiming at nurturing relationships rather than controlling it;

(v) **Locus of decision making:** Giving autonomy to the managers in making decisions to handle local difficulties with the relationships;

(vi) **Top management commitment:** Top management commitment and involvement should be there throughout the relationships; and

(vii) **Compatibility:** Operational and cultural differences should not hinder the collaborations so that relationships can be successful avoiding the incompatible values.

Collaboration is a process of joint planning and decision making (Lajara et al., 2004) among all partners so as to improve the overall supply chain performance. The benefits of a proper collaboration are plenty and can be resulted in higher profitability and service improvements. Stank, Keller and Daugherty (2001) have studied the relationship between collaboration and service improvement in supply chains. Their findings reveal that internal collaboration considerably influences logistical service performance. Furthermore the external collaboration in the supply chain influences internal collaboration positively which consequently improves logistical service. Collaboration is utmost needed both within and beyond the firm's boundaries which in turn requires more resources and a flair for it.

Partnership is an important aspect of successful supply chain management (Lambert, Knemeyer, & Gardner, 2004; Pyke et al., 2000). According to the authors although the supply chain brings many opportunities still the real opportunities for the better performance come from effective relationships among the partners. They have identified eight drivers of successful partnership. They are namely:

- Planning
- Joint operating control
- Communications
- Risk and sharing reward sharing
- Trust and commitment
- Contract style
- Scope
- Investment

Organisations are attempting to gain a competitive advantage by integrating their suppliers into the supply chain processes which ultimately require greater strategic and operational cooperation between the buyer and supplier. With the advancement of the information technology the firms are sharing their planning information with each other quickly and accurately to make effective collaborative planning. The trust and quality of information sharing between the firms are most important factors for the effective collaborative planning (Doney & Cannon, 1997; Petersen, Ragatz, & Monczka, 2005).

According to Seifert (2007) the "CPFR is an initiative among all participants in the supply chain intended to improve the relationship among them through jointly managed planning processes and shared information." The concept is coined by Wal-Mart and Warner-Lambert in United States which primarily intended to reduce the inventory costs throughout the supply chain. The CPFR has been proved to benefit the supply chains in the following ways (Fraser, 2007):

- Improves forecasting accuracy
- Decreases inventory level
- Reduces stock-outs
- Improves service level
- Increases sales

Keeping view to citations on supply chain coordination, three coordination mechanisms are being discussed in this research. They are namely procurement-production coordination (Goyal & Deshmukh, 1992), production-distribution coordination (Sarmiento & Nagi, 1999) and coordination issues in third party logistics provider (Huiskonen & Pirttila, 2002).

The milk producers, dairy cooperative societies, bulk milk coolers and production plant are the respective stakeholders in the procurement-production coordination. While the production plant and transporting agencies are associated with the production-transportation interface; the production plant and the retail outlets are being involved into production-distribution coordination phases. Goyal et al. (1992) focus on the two coordination mechanism viz. supply chain contracts and joint decision making process where cost has been taken as the measure of the performance. Huiskonen and Pirtilla

(2002) also have used the same mechanism of coordination in their study to measure the logistics performance.

2.8 Supply Chain Performance

Supply chain management practices are widely prevalent in today's business scenario irrespective of the nature of the firm. Since the supply chain work under a diversified working environment, most of the times, it is essential to measure the performance of the stakeholders including the customers' satisfaction. But the performance measurement of any entity is not an easy task to deal with. This requires a valid and reliable instrument, which further requires an extensive background work and expertise. To make the study more precise and practical some of the findings of the academicians, researchers and practitioners in this field have been cited hereunder.

Supply chain performance measurement has been one of the key issues for the organisations to identify their stand in the market place. Since the supply chain considers several stakeholders in the system, in order to measure the performance, it is essential to measure the performance of the individual stakeholder. The performance level of the organisation is greatly influenced by the performance of the individual stakeholder – may be positive or negative. If the performance of each of them is positive and optimal then it adds to the overall performance of the chain. So in order to see the better performance of the supply chain it is essential to have relatively better performance in case of individual stakeholders.

In order to measure the performance of the supply chain it is necessary to have a proper measuring instrument with requisite parameters. All of these parameters or key performance indicators (KPIs) may or may not be applicable to each stakeholder in the system. Even applicable it is difficult to say that it impacts every stakeholder in the same way. This is due to the conflicting objectives among supply chain partners which often brings out sub-optimal results, may be detrimental to the overall performance of the chain (Aramyan, Lansink, Van der Vorst, & Van Kooten, 2007). This conveys that a parameter set by a stakeholder in his/her day to day operational activities without due consultations with others might not result in the same way what he/she extracts out of it.

Sometimes in order to improve the supply chain performance it is essential to compare it with the other best performers in the field (benchmarking). Benchmarking is a process of identifying the best practice and modifying actual knowledge to achieve superior performance in the organisation (Camp, 1989; Splendolini, 1992). It can be used both internally and externally where internal benchmarking is to develop the inferior departments in the organisation; the external benchmarking is to compare with the other organisations performing well. According to Splendolini (1992) there are five basic steps of benchmarking namely:

(i) Strategy: planning for short and long term;

(ii) Forecasting: predict trends;

(iii) New ideas: stimulate new thoughts;

(iv) Process comparisons and

(v) Setting objectives and targets: base them on best practice.

Supply chain management has been a very complex phenomenon. Firms are now taking utmost care to exist sustainably in the market place. That's the reason why benchmarking is overwhelmingly exercised by them to know their drawbacks and fortes compared to the competitors.

Anderson, Fagerhaug and Randmael (n.d) elaborated the benchmarking process flow which includes the steps of measurement, comparison, learning and improvement:

- Measurement of own and benchmarking partners performance level both for comparison and for registering improvements
- Comparison of performance level processes
- Learning from the benchmarking partners to introduce improvements
- Improving the performance levels, processes etc.

They have also stated some of the major challenges for the benchmarking process. Difficulty in finding benchmarking partners, sharing of information, lack of understanding between partners and comparability of companies and processes are major impediments in the benchmarking process. As a part of the benchmarking it is essential to improve the process of the organisation which comes in varying degrees.

According to Bohn (1994) as said in Slack and Lewis (2009) there are eight stages ranging from "total ignorance" to "complete knowledge" for process development.

(i) **Complete ignorance:** There is absolutely no knowledge of what is significant in the process;

(ii) **Awareness:** There is awareness that certain phenomena exist and their relationship to the process but there is no formal measurement or understanding of how they affect the process;

(iii) **Measurement:** There is an awareness of significant variables that affects the process but there is no control on them in the process;

(iv) **Control of mean:** There is some ideal to control the significant variable but the control is not precise. In this case the mean is controlled but not the variations around the mean;

(v) **Process capability:** The knowledge exists to control both the average and the variations in case of significant variables;

(vi) **Know how:** In this case the knowledge exists to know how the variables affect the output and which can get adjusted to optimise the process;

(vii) **Know why:** The scientific knowledge exists in this case which can control, predict the variables in a wide range of diversifying conditions and

(viii) **Complete knowledge:** This an ideal condition, as good as working at more than six sigma level. It is never reaching condition since it is virtually impossible to know the effects of every conceivable variables and conditions thereto.

According to Neely, Gregory and Platts (1995) performance measurement is the process of quantifying the effectiveness and efficiency of various actions. They have revealed that the efficiency is the measure of economic activities of the farm whereas the effectiveness is the extent to which customers' requirements are met. So clearly in order to measure the performance of the chain it is essential to measure both the performance of supply chain partners including the customers' satisfaction. They have also identified quite a good number of approaches to the measurement system viz. balanced score card method, performance measurement matrix and questionnaire etc. Short-termism, lack of strategic focus, system not aligned with strategic goals and organisation culture etc. are some of the major limitations adhered to the measurement system, they have included thereto.

Anderson (1995) has suggested a benchmarking wheel for the organisations with five different stages namely plan, search, observe, analyse and adapt as depicted in the figure 2.3.

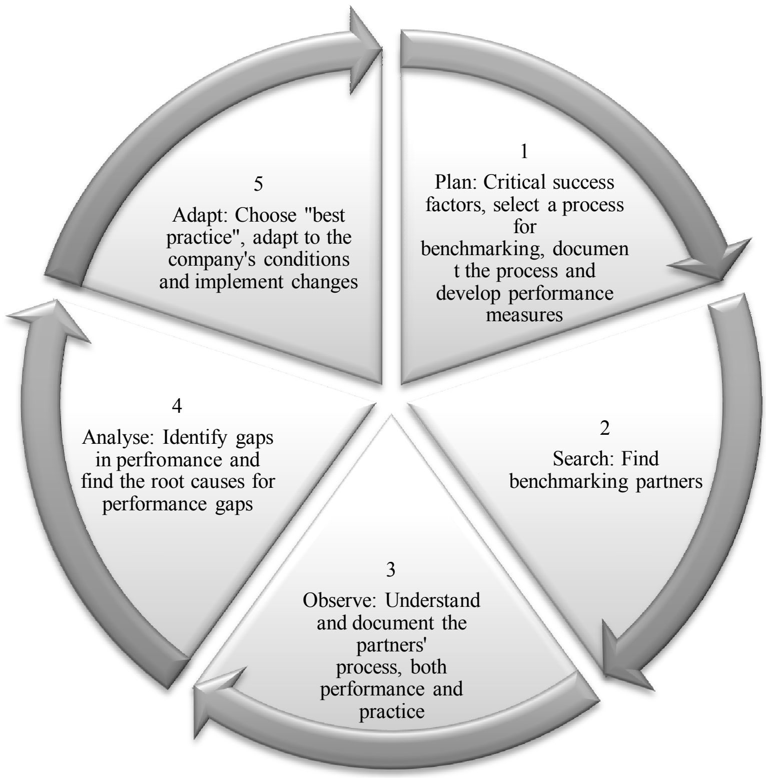


Figure 2.3: Benchmarking wheel

Source: Anderson (1995)

Van der Vorst, Beulens, DeWit and Van Beek (1998) mentioned that supply chains should be concerned with the reduction or even elimination of uncertainties to improve the performance of the chain. Order forecast horizon, input data and administrative and decision policies are three major causes of uncertainty in the supply chain. The inherent uncertainties relating to the demand and supply add to the supply chain uncertainties. In order to avoid these complicacies organisations should follow supply chain activities together with the internal control design. Furthermore the authors have cited that a proper coordination mechanism is essential to maximise the benefits of the supply chain activities. There are certain drivers of increasing interest in the supply chain performance measurement.

According to Neely (1999) there are seven drivers for increasing interest in supply chain performance measurements. They are namely:

- Changing nature of work
- Increased competition

- Specific improvements initiatives like just-in-time and so on
- National and international quality awards
- Changing organisational roles like management by objective (MBO)
- Changing external demands
- The power of information technology

Christopher and Towill (2000) presented various models of supply chain performance measurement which being condensed in the table below:

Table 2.4: Supply chain performance models

Types of supply chain	**Supply chain performance**		
	Supply chain measure	**Supply chain sub-measure**	**Supply chain metric**
Efficient	Cost, price (market winner)	Total chain cost Purchasing price	USD/purchased item
Quick/Agile/ Market responsive	Delivery Quality Flexibility (market winner) Cost	Delivery reliability Quality conformance Flexibility (mix) of production Total chain cost	Percentage PPM Percentage USD/purchased item
Lean	Primary: Cost (market winner) Quality Secondary: Delivery, Novelty and Customer service	Total chain cost Purchasing price Quality conformance Delivery reliability, Delivery (lead time)	USD/purchased item PPM Percentage Weeks
Hybrid (lean & quick/agile/market responsive)	Quality Delivery Cost Flexibility	Quality conformance Delivery reliability Total chain cost Purchasing price Flexibility (mix) of production	PPM Percentage USD/purchased item Percentage

Source: Christopher and Towill (2000)

According to them there are four kinds of supply chains which require various performance measurement parameters. If the supply chain is an efficient one then cost and price are the major indicators to be considers. While there are not much difference found in case of quick/agile/market responsive and hybrid supply chains - lean supply chains focus on novelty and customer service. Monczka et al. (2002) in their book on purchasing and supply chain management have stated the benefits and problems with measurement of the supply chain management. According to them:

> The fundamental objective of a purchasing and supply chain performance measurement system is to aid in strategy implementation through a formal, systematic approach to monitoring and evaluating purchasing activities. Managers can use several types of information to achieve this goal: the most effective blend financial information with non-financial information. (p.144)

Furthermore they have stated that - improved decision making, improved level of communication and identification of flaws are some of the major benefits that can be achieved if measurement of supply chain performance is done on regular basis. But sometimes due to conflicting messages from the stakeholders and lack of congruence in the objective formulation the measurement can't retrieve the facts of the supply chain.

Chopra and Meindl (2003) have mentioned that in order to achieve strategic fit in the supply chain it is necessary to understand the customers and uncertainties. They have also cited that since the scope of strategic fit is to include all channel partners, it is essential to have a common framed goal irrespective of its members. Individual goals, though profitable for the concerned, do not much add value to the supply chain's performance.

Supply chain performance indicators viz. efficiency, responsiveness, flexibility, product quality and process quality are all indispensable part of the supply chain. However the flexibilities like volume, delivery, system, supply, organisational and information flexibility are some of the major sub-indicators which influence the overall performance of the supply chain. The higher is the ability of the firm to change its production and delivery to the customers (as a part of the flexibility) the higher is the value addition to the total supply chain profitability (Vickery, Canlantone, & Droge, 1999; Duclos, Vokura, & Lummus, 2003; Garavelli, 2003).

Sankaran and Luxton (2003) have discussed about the factors which facilitate and/or inhibit the supply chain efficiency in dairy industry. The factors are namely; the payment system, cooperative ownership structure and vertically integrated nature of the industry. The systematic payment system together with the incentives to the farmers improves the operation of the cooperatives but the collection of milk beyond its capacity results in diseconomies of scale. The cooperative ownership avoids the non-cooperative behaviours on the part of the dairy farms but it is essential to process the milk supplied by the suppliers irrespective of the extent. Similarly the vertical integration helps in system-wide improvements while there is a chance of distorted behaviour on the part of the cooperatives due to the employment of the financial model for remunerating them.

Gunasekaran et al. (2004) in order to measure the supply chain performance have developed and sent a questionnaire to 150 industries in the UK with a response rate of 14 percent. The questionnaire has got four basic sections namely; plan, source, produce and delivery at different levels of the organisations. The findings of the study say that 76 percent of the industries get benefited out of the supply chain management practices by improving their return on investment (ROI). Around two third of the respondents agree that their market share have gone up due to implementation of the various supply chain practices. But the success of the industries is not automatic unless due care has been given to the measurement of the supply chain in regular interval of time. They have also revealed that there should be a common goal for the entire chain irrespective of the stakeholders – the goals could be customer satisfaction and the enhanced competitiveness.

For measuring the performance of logistics and supply chain it is essential to include both financial and non-financial terminologies. Costs, profits, ROIs etc. are the financial measures whereas productivity, asset management, order fulfilment and quality are the non-financial measures. Both of these financial and non-financial measures are pertaining to the internal indicators whereas customer perceptions, service quality, reliability, responsiveness, relationship, learning and innovations are the external measures. In order to measure the performance of the logistics both of internal and external measures are important (Kaplan & Norton; 1996; Sople, 2004).

According to the Huang, Sheoran and Wang (2004) there are four basic measures by which the supply chain performance can be measured. They are according to supply chain operations reference (SCOR, www.supply-chain.org/scor) namely; plan, source, make and deliver. Planning is the basic principle of any business concern followed by sourcing where the raw materials are procured and transformed into products and services by a proper throughput. Once the product or service is in its finished form of consumption or delivering, it is delivered to the prospective customers. The whole process comes through certain stages. While the planning is done at the strategic level; sourcing is done at the tactic level. Making and delivering of the same is performed at the operational level of the supply chain. Huang et al. (2004) have suggested eight different parameters of supply chain performance based on the SCOR model as mentioned below:

- Cost
- Inventory turnover
- Quality
- Lead time
- Delivery precision
- Internal performance
- Customer satisfaction
- Service grade

Bozarth and Handfield (2006) have mentioned that operations and supply chain can have enormous impact on the business performance. They suggested that quality, time, flexibility and cost are the four basic dimensions relevant to operations and supply chain activities. Slack and Lewis (2009) have suggested six indicators to measure the operational performance in the organisation. They are namely; quality, speed, dependability, flexibility, cost and process knowledge.

- **Quality:** No. of defects per unit, level of customer complaints, scrap level, warranty claims, mean time between failures and customer satisfaction score etc. can be taken into consideration while referring to the quality factor.
- **Speed:** Customer query time, order lead time, frequency of delivery, actual versus theoretical throughput time and cycle time.
- **Dependability:** Percentage of orders delivered late, average lateness of orders, proportion of products in stock, mean deviation from promised arrival and schedule adherence.
- **Flexibility:** Time needed to develop new products or services, range of products or services, machine change-over time, average batch size, time to increase activity rate, average capacity or maximum capacity and time to change schedules are the deciding factors in this case.

- **Cost:** Minimum delivery time or average delivery time, variance against budget, utilisation of resources, labour productivity, added value, efficiency, cost per operation hour.
- **Process knowledge:** The key to excel in the field of operation is to have the proper process knowledge. Though it's difficult or sometimes impossible to have a perfect knowledge for certain process still things will continue to improve when people try to come closer towards it. The process improvement is like a journey where there is always a scope for further improvements.

Food Chain Centre of UK (Nov 2007) has mentioned that the dairy industry is wasting £1.5 billion per year. The big amount of loss is attributed to all the stakeholders in the system collectively which could have been saved by referring to some of the key strategies of the supply chain management. According to the report one of the best ways to curb this wastage is to apply lean manufacturing to the industry by adopting following steps. The steps are basically as hereunder:

- Operational management (milk production, quality improvement)
- Transport inefficiency (milk collection, distribution)
- Reducing information complexity
- Demand management
- Introducing overall supply chain key performance measures
- Developing a better understanding of customer value

Performance measurement of transporters can be done by considering financial measures as well as non-financial measures being brought under the purview of internal and external measures. Sople (2004) has elaborately discussed about the performance measurement in the transportation industry with the following financial and non-financial parameters. Among the financial measures operating costs and return on investment (ROI) are the major indicators. As far as non-financial measures are concerned it is the productivity, asset management, order fulfilment and quality are the major indicators.

More over there are some external indicators too on the basis of which the customers' perceptions of the service quality can be measured. The details of the parameters are as discussed below:

<u>(A) Internal measures:</u>

(i) Financial/Operating cost:

- Warehousing cost per unit
- Freight cost per unit of material transported
- Labour cost
- Cost of goods damaged during transportation
- Logistical packaging cost
- Order processing cost
- Per unit (throughput) cost in warehousing
- Administration cost

(ii) Financial/Return on Investment (ROI)

(iii) Non-financial/Productivity:

- Units loaded per person per hour onto the transport vehicles
- Cases filled and packed per person per eight hour shift
- Idle time of the handling equipment
- Throughput in the warehouse per hour

(iv) Non-financial/Asset management:

This is a measurement of inventory turnover ratio, ROI and inventory stock levels in a particular number of days. Inventory turnover ratio indicates the rotation of the given value of inventory w.r.t the value of sales in a stipulated timeframe (generally one year). Higher ratio indicates faster cash rotation in the business cycle and higher utilisation of assets.

(v) Non-financial/Order fulfilment:

- Cycle time (order processing, replenishment, procurement, manufacturing and distribution)
- Delivery (on-time or delayed)
- Fill rates (order fill, case fill, product fill)
- Stock out frequency

- Shipping errors (wrong delivery, incorrect invoice, and material shortage)

(vi) Non-financial/Quality:

- Transit damage frequency
- Value of the total damage
- Frequency and cost of goods returned from the customers (damaged or inferior quality)
- Material shortages frequency
- Delivery commitment deviations (frequency and tolerance)

<u>(B) External measures:</u>

(i) Customer perceptions:

- Service quality
- Reliability
- Responsiveness
- Relationship

(ii) Innovations (best practices/benchmarking):

- Order processing procedure
- Transportation (route, modes, freight rationalization)
- Warehousing (storage, material handling system, automation)
- Packaging
- Logistical productivity
- Delivery service
- Information flow and connectivity

Aramyan (2007) have considered exhaustive list of indicators proposed by various authors like; efficiency, responsiveness, flexibility, product quality and process quality in their study of "performance measurement in agri-food supply chains". They have carried out this study in case of Dutch-German tomato supply chain by considering one breeder, seven tomato grower, one wholesaler, one distributor and two retailers. The twelve stakeholders have been interviewed by them on the basis of a structured questionnaire with both open and closed ended questions under a five-point rating Likert scale. They have concluded that many indicators are used on the basis of objectives of the stakeholders which complicate the harmonisation of performance measures for the entire chain. At the end they have suggested a four dimensional performance measurement system for the agri-food supply chain. The dimension-wise indicators as per their study have been mentioned hereunder:

- Efficiency : Costs, profit, return on investment
- Flexibility : Mix flexibility, volume flexibility
- Responsiveness : Lead time, customer complaints
- Food quality : Appearance, product safety

A report from Confederation of Indian Industries (CII) and Technopak (2010) has focused on the Public Private Partnership (PPP) model of the Indian dairy sector for better performance. The private parties can be integrated into the sector so as to improve the performance in many ways. They are namely:

- Procurement and processing
- Infrastructure and logistics development
- Operations management
- Capacity building through training and extension
- Research and knowledge transfer

The supply chain of any organisation has to come across various adverse situations in the form of risks and uncertainties. These risks and uncertainties often plunge to the supply chains by disrupting its flow and bring damage to it. In order to have a better performance in the chain it is highly imperative to consider the risks and uncertainties which are not usually mentioned in the set of indicators. The concept of risk and uncertainty are not being mentioned in the study made by Aramyan et al. (2007). The actual performance of the supply chain not only depends upon the set of operational indicators rather depend upon the risk factors too. Though it is difficult to generalise the contribution of each to the overall performance of the chain still there is a need to concentrate on both of these dimensions.

2.9 Conclusion

Supply chain management has emerged as one of the most sought after strategies in the organisations. It entangles all the processes ranging from the suppliers' supplier to the customers' customers to make the product reach the end point on time with the respective stakeholders' satisfaction. The macro-processes which come under the gamut of supply chain are supplier relationship management (SRM), internal supply chain management (ISCM) and customer relationship management (CRM). Whilst the SRM deals with the procurement side of the supply chain, ISCM deals with the internal affairs like production and operation. CRM deals with all the processes that are required to enhance the market share and the customer satisfaction. Each strategy in the supply chain are inextricably related to each other without which the there may be a chance of supply chain breakdown or sub-optimal level of overall value generation. On the contrary the benefits of the practices are manifold and appear in the form of enhanced supply chain performance. With respect to the study macro-processes of the supply chain at each level of the supply chain are discussed so as to make it wide and more practical. The views of academicians, researchers and practitioners have been reiterated in the chapter to the make the study more precise and logical without making any change in the sense and represented in the same order what they are meant to talk about.

2.10 References

Agrawala, S. P. (2003). Development of equipments for manufacture of Indian milk products and future strategy. *Indian Dairyman, 55*(8), 33-37.

Akcaoz, H., Kizilay, H., & Ozcatalbas, O. (2009). Risk management strategies in dairy farming: A case study in Turkey. *Journal of Animal and Veterinary Advances, 8*(5), 949-958.

Alder, H. (2007). Supply chain vulnerability. In J. Reuvid (Ed.), *Managing business risk: A practical guide to protecting your business* (3rd ed., pp. 54-61). New Delhi: Kogan Page India.

Ali, J., & Kapoor, S. (2008). Farmers' perception on risks in fruits and vegetables production: An empirical study of Uttar Pradesh. *Agricultural Economic Research Review, 21*(Conference Number), 317-326.

Anderson, B. (1995). *The results of benchmarking and a benchmarking process model*. Unpublished doctoral dissertation. Norwegian Institute of Technology: Norway.

Anderson, B., Fagerhaug, T., & Randmael, S. (n.d). *Benchmarking supply chain management: Finding best practices*. Norway: SINTEF, Industrial Management Department.

Aramyan, L. H. (2007). *Measuring supply chain performance in the agri-food sector*. Wageningen University, Wageningen, Netherlands.

Aramyan, L. H., Lansink, A. G. J. M. O., Van der Vorst, J. G. A. J., & Van Kooten, O. (2007). Performance measurement in agri-food supply chains: A case study. *Supply Chain Management: An International Journal*, *12*(4), 304-314.

Ashok Kumar, P., & Sayulu, K. (2007, December). Procurement and processing practices of dairy products – A study of Karimnagar dairy. *SEDME, 34*(4), 57-71.

Ayers, J. B. (2001). A primer on supply chain management. *Handbook of Supply Chain Management*. Florida: Auerbach Publication.

Banerjee, A. (2008). Indian milk products export. *Indian Dairyman, 60*(5), 23-25.

Barman, K., Konwar, D., & Kumar, R. (2008). Scientific management – A road to profitable dairy farming. *Indian Dairyman, 60*(10), 68-73.

Basmaci, O. S. (2003). *Supply chain collaboration: A case study in textile industry*. Unpublished M.Sc dissertation, Graduate School of Engineering and Natural Sciences, Sabanci University, Istanbul.

Bechtel, C., & Jayaram, J. (1997). Supply chain management: A strategic perspective. *International Journal of Logistics Management, 8*(1), 15-34.

Biemans, W. G., & Brand, M. J. (1995). Reverse marketing: A synergy of purchasing and relationship marketing. *International Journal of Purchasing and Materials Management, 31*(3), 29-37.

Boehlje, M. (1999). Structural changes in the agricultural industries: How do we measure, analyze, and understand them. *American Journal of Agricultural Economics, 81*(5), 1028-1041.

Bowersox, D. J. (1997). Lessons learned from the world class leaders. *Supply Chain Management Review, 1*(1), 61-67.

Bozarth, C., & Handfield, R. B. (2006). *Introduction to operation and supply chain management*. New Delhi: Pearson Education.

Camp, R. C. (1989). *Benchmarking: The search for industry best practices that lead to superior performance*. New York: Quality Resources.

Carr, A. S., & Smeltzer, L. R. (1999). The relationship of strategic purchasing to supply chain management. *European Journal of Purchasing & Supply Management, 5*, 43-51.

Chopra, S., & Meindl, P. (2003). *Supply chain management: Strategy, planning and operation*. New Delhi: Pearson Education.

Christopher, M. (1998). Logistics and supply chain management: Strategies for reducing cost and improving service (2nd ed.). Great Britain: Financial Times/Prentice Hall

Christopher, M., & Towill, D. (2000). Supply chain migration from lean and functional to agile and customised. *Supply Chain Management: An International Journal, 5*(4), 206-213.

Cookson, C., & Delattre, A. (2001). Collaborative manufacturing: A new supply chain opportunity. *Supply Chain Management Review Global Supplement, January-February,* 10-14.

Council of Logistics Management. (1998). Oak Brook, IL: Council of Logistics Management (www.clm1.org/)

Cox, A. (1997). *Business success: A way of thinking about strategy, critical supply chain assets and operational best practice*. Boston: Earlsgate Press.

Cox, A., Ireland, P., Lonsdale, C., Sanderson, J., & Watson, G. (2001). *Supply chains, markets, and power: Mapping buyer and supplier power regimes*. New York: Routledge.

Das, B. C., & Malik, B. S. (2005). Self help groups and dairy farming. *Indian Dairyman, 75*(2), 53-57.

Deb, M., Mishra, D., Guin, K. K., & Sinha, G. (2007, March). Impact of food marketing on customer relationship in India – A fuzzy logic approach. *Vilakshan*, 148-164.

Dixit, G. (2008). Present dairy scenario – Help or assistant to all sectors of dairy business (to minimise the gap between all sectors like govt., cooperative and private). *Indian Dairyman, 60*(4), 67-69.

Doney, P. M., & Cannon, J. P. (1997). An examination of the nature of trust in buyer–seller relationships. *Journal of Marketing, 61*(2), 35-61.

Duclos, L. K., Vokura, R. J., & Lummus, R. R. (2003). A conceptual model of supply chain flexibility. *Industrial Management & Data Systems, 106*(6), 446-456.

Ellram, L. M., & Cooper, M. C. (1990). Supply chain management, partnerships and the shipper – Third party relationships. *International Journal of Logistics Management, 1*(2), 1-10.

Faes, W., & Matthyssens, P. (2009). Insights into the process of changing sourcing strategies. *Journal of Business & Industrial Marketing, 24*(3/4), 245–255.

Fitzgerald E., McIntosh, G., & Akintoye, A. (2000). A survey of supply chain collaboration and management in the UK construction industry. *European Journal of Purchasing and Supply Management*, 6, 159-168.

Fodder shortages in Chittoor district of Andhra Pradesh. (2010, April 22). *Times of India (Hyderabad)*, p. 4.

Food and Agricultural Organisation of the United Nations. (1955). *Cooperative marketing for agricultural products* (paper no. 53). Rome, Italy: Author.

Food Chain Centre. (2007, November). *Applying lean thinking to the dairy Industry*. UK: Author.

Fraser, J. (2007). CPFR – status and perspectives: Key results of a CPFR survey in the consumer goods sector and updates. In D. Seifert (Ed.), *Collaborative planning, forecasting, and replenishment* (pp. 70-93). New Delhi: Prentice Hall of India.

Garavelli, C. A. (2003). Flexibility configurations for the supply chain management. *International Journal of Production Economics, 85*, 141-153.

Ghanekar, D. V. (2008). Taxing dairy coops: A case for reconsideration. *Indian Dairyman, 60*(3), 108-111.

Gorton, M., Dumitrashko, M., & White, J. (2006). Overcoming supply chain failure in the agri-food sector: A case study from Moldova. *Food Policy, 31*, 90–103.

Goyal, S. K., & Deshmukh, S. G. (1992). Integrated procurement – production systems: A review. *European Journal of Operational Research, 62*(1), 1-10.

Gray, C. F., & Larson, E. W. (2008). *Project management: The managerial process* (3rd ed.). New Delhi: Tata McGraw-Hill.

Gunasekaran, A., Patel, C., & McGaughey, R. E. (2004). A framework for supply chain performance measurement. *International Journal of Production Economics*, *87*, 333-347.

Harrison, A., & Van Hoek, R. (2005). *Logistics Management and Strategy* (2nd ed.). Essex: Pearson.

Huang, S. H., Sheoran, S. K., & Wang, G. (2004). A review and analysis of supply chain operations reference (SCOR) model. *Supply Chain Management: An International Journal*, 9(1), 23-29.

Huiskonen, J., & Pirttila, T. (2002). Lateral coordination in a logistics outsourcing relationship. *International Journal of Production Economics, 78* (2), 177-185.

IFCN. (2008). *IFCN dairy report: For a better understanding of milk production world-wide*. Kiel, Germany: Author. Retrieved 7 April, 2009, from www.ifcndairy.org

Indian Council for Agricultural Research. (2002). *Handbook of animal husbandry*. New Delhi: Author.

Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behaviour, agency costs and ownerships structure. *Journal of Financial Economics, 3*(4), 305-360.

Jithendra Kumar, D. S., & Shankara Murthy, H. G. (1992). Impact of dairy cooperatives on income and employment in Chittoor district, Andhra Pradesh – An economic analysis. *Indian Cooperative Review, 29*(4), 382-388.

Jones, T. C., & Riley, D. W. (1987). Using inventory for competitive advantage through supply chain management. *International Journal of Physical Distribution and Materials Management, 17*(2), 94-104.

Juha, M., & Pentti, J. (2008). Managing risks in organisational purchasing through adaptation of buying centre structure and the buying process. *Journal of Purchasing & Supply Management, 14*, 253–262.

Juran, J. M. (1988). *Quality planning and analysis*. New York: McGraw-Hill

Juttner, U. (2005). Supply chain risk management: Understanding the business requirements from a practitioner perspective. *International Journal of Logistics Management, 16*(1), 120-141.

Kaipia, R. (2007). *Supply chain coordination – studies on planning and information sharing mechanisms*. Unpublished doctoral dissertation, Helsinki University of Technology, Helsinki, Finland.

Kano, N., Seraku, N., Takahashi, F., & Tsuji, S. (1996). Attractive quality and must-be quality. *The Journal of the Japanese Society for Quality Control, 14*(April), 39-48.

Kaplan, R. S., & Norton, D. P. (1996). Using the balanced scorecard as a strategic management system. *Harvard Business Review, 74*(1), 75-85.

Karki, B. B. (2005). Strategic planning in cooperative sector: A study on dairy cooperative. *The Journal of Nepalese Business Studies, 2*(1), 72-80.

Karmakar, K. G., & Banerjee, G. D. (2006). Opportunities and challenges in the Indian dairy industry. *Technical Digest, 9*, 24-27.

Kaur, P., Bhullar, A. S., Singh, M., & Kaur, I. (2008). Growing importance of dairy in the economy of the marginal and small farmers in Punjab. *Journal of Agricultural Development & Policy, 18*(1/2), 36-46.

Khan, A. K., & Pillania, R. K. (2008). Strategic sourcing for supply chain agility and firms' performance: A study of Indian manufacturing sector. *Management Decision, 46*(10), 1508-1530.

Khanna, R. S. (2003). Cybernetics and the dairy development. *Indian Dairyman, 55*(4), 43-56.

Khanna, R. S. (2005). Sustainable development of the dairy industry in Asia – Challenges and opportunities. *Indian Dairyman, 57*(2), 21-29.

Khanna, R. S. (2008). Ensuring revolution in milk production system: Getting the best from the India's cattle and buffaloes. *Indian Dairyman, 60*(3), 37-43.

Knolmayer, G., Mertens, P., & Zeier, A. (2002). *Supply chain management based on SAP systems.* Heidelberg, Germany: Springer.

Kohl, R. L., & UHL, J.N. (2002). *Marketing of agricultural products*. New Delhi: Prentice Hall of India.

Kotler, P. (2000). *Marketing management*. New Delhi: Pearson Publications

Lajara, B. M., & Lillo, F. G. (2004). SMEs and supplier alliance use: An empirical analysis. *Supply Chain Management: An International Journal, 9*(1), 71-85.

LaLonde, B. J. (1984). A reconfiguration of logistics systems in the 80s: Strategies & challenges. *Journal of Business Logistics, 4*(1), 1-11.

Lambert, D. M., Knemeyer, A. M, & Gardner, J. T. (2004). Supply chain partnerships: Model validation and implementation. *Journal of Business Logistics, 25*(2), 21-42.

Larson, P. D., & Halldossson, A. (2002). *SCM: The four perspectives model*. Norway: Nordic Logistics Research Network (NOFOMA).

Lee, H. L. (2006). The triple - A supply chain. *Harvard Business Review on Supply Chain Management, III series*, 87-115.

Lee, H. L., Padmanabhan, V., & Whang, S. (1997). The bullwhip effect in supply chains. *Sloan Management Review, Spring*, 93-102.

Lo, V. H. Y., & Yueng, A. H. W. (2004). Practical framework for strategic alliance in Pearl River delta manufacturing supply chain: A total quality approach. *International Journal of Production Economics, 87*, 230-240.

Loarne, S. L. (2005). Working with ERP systems – Is big brother back? *Computers in Industry, 56*(6), 523-528.

Malone, T., & Crowston, K. (1994). The interdisciplinary study of coordination. *ACM Computing Surveys, 26*(1), 87-119.

Mentzer, J. T., Dewitt, W., Keebler, J. S., Min, S., Nix, N. W., Smith, C. D., et al. (2001). Defining supply chain management. *Journal of Business Logistics, 22*(2), 1-25.

Milk demand growing faster than production: NDDB. (2010, February 18). *Business Standards.* Retrieved August 2, 2010, from http://www.businessstandards.org

Ministry of Finance, Government of India. (2007-08). *Economics survey*. New Delhi: Author. Retrieved from http://www.indiabudget.nic.in/

Mintzberg, H. (1980). *The nature of managerial work* (2nd ed.). Englewood Cliffs, NJ: Prentice hall.

Misra, R. K., & Pal, P. K. (2003). Prospects and constraints of dairying in rural Bengal: A case study. *Indian Dairyman, 55*(12), 55-59.

Mitra, S. (2008). Dynamics and prospects of the Indian logistics industry. *Productivity, 48*(4), 553-562.

Monczka, R., Trent, R., & Handfield, R. (2002). *Purchasing and supply chain management* (2nd ed.). Singapore: Thomson Learning.

Nataraj, B. S. (2005). *Marketing of milk and milk products opportunities for entrepreneurship*. Karnal, Gurgaon: National Dairy Research Institute.

Neely, A. (1999). The performance measurement revolution: why now and what next. *International Journal of Operations & Production Management, 19*, 205-228.

Neely, A., Gregory, M., & Platts, K. (1995). Performance measurement systems design: A literature review and research agenda. *International Journal of Operations and Production Management, 15*(4), 80-116.

Nix, N., Zacharia, Z. G., Lusch, R. F., Bridges, W. R., & Thomas, A. (2004). *Keys to effective supply chain collaboration: A special report from collaborative practices research programme*. USA: TCU, M. J. Neeley School of Business, Supply and Value Chain Centre.

Noordhuizen, J. P. (2003). Hazard analysis and critical control points. *Encyclopaedia of dairy sciences: Vol. 3*. (pp. 1281-1294). UK: Elsevier Science Ltd.

Oliver, R. L. (1980). A cognitive model for the antecedents and consequences of satisfaction decisions. *Journal of Marketing Research, 17*, 460-469.

Painter, M. J. (2007). A comparison of the dairy industries in Canada and New Zealand, *Journal of International Farm Management, 4*(1), 1-20.

Penrose, E. T. (1959). *The theory of the growth of the firm*. New York: Oxford University Press.

Petersen, K. J., Ragatz, G. L., & Monczka, R. M. (2005). An examination of collaborative planning effectiveness and supply chain performance. *The Journal of Supply Chain Management, Spring 2005*, 14-25.

Pfeffer, J. & Salancik, G. R. (1978). *The external control of organisations: A resource dependence perspective*. New York: Harper.

Planning Commission, Govt. of India. (2001, August). *Draft report of the working group on animal husbandry and dairying for five-year plan (2002-2007)*. New Delhi: Author.

Pooler, V. H., & Pooler, D. J. (2004). *Purchasing and supply management: Fulfil the vision* (2nd ed.). Dordrecht: Kluwer Academic Publishers.

Porter, M. (1980). *Competitive strategy: Techniques for analysing industries and competitors*. New York: The Free Press.

Prasad, J. (2005). *Principles and practice of dairy farm management*. New Delhi: Kalyani Publishers.

Presutti, W. D. Jr. (2003). Supply chain management and e-procurement: Creating value added in the supply chain. *Industrial Marketing Management, 32*, 219-226.

Pyke, D., Robb, D., & Farley, J. (2000). Manufacturing and supply chain in China: A survey of state-, collective-, and privately owned enterprises. *European Management Journal, 18*(6), 577-589.

Rajgopal, D. (1996). Competition in dairy industry: A study of marketing strategy in Andhra Pradesh. *Cooperative Perspective, 30*(4), 22-29.

Ramaiah, M. J. (2008). Rural development through dairy farming. *Indian Dairyman, 60*(5), 64-67.

Ramaiah, M. J. (2008). Rural development through dairy farming. *Indian Dairyman, 60*(5), 64-67.

Ramaswami, B., Ravi, S., & Chopra, S. D. (2004). *State of the Indian farmer: Risk management* (Vol. 22). New Delhi: Academic Foundation.

Ramdas, K., & Spekman, R. E. (2000). Chain or shackles: Understanding what drives supply chain performance. *Interfaces, 30*(4), 3-21.

Ramkishen, Y. (2003). *Management of cooperatives: History, theory, sectors and case studies*. Mumbai: Jaico Publishing House.

Rangasamy, N., & Dhaka, J. P. (2007). Marketing procurement cost for cooperative and private dairy plants in Tamil Nadu: A comparison. *Indian Journal of Agricultural Economics Research Review, 62*(4), 679-693.

Rangasamy, N., & Dhaka, J. P. (2008). Marketing efficiency of dairy products for co-operative and private dairy plants in Tamil Nadu: A comparative analysis. *Agricultural Economics Research Review, 21* (July-December), 235-242.

Rao, S., & Sharma, K. P. (2003). Problems of dairy cooperatives in (Urmul) Bikaner, Rajasthan. *Indian Dairyman, 55*(11), 41-47.

Rathinam, R. (2008). Super market retailing of dairy products – Challenges & opportunities. *Proceedings of the Dairy India Conference, New Delhi*, 19-21.

Richardson, R. M., Adams, C. C., DeVille, K. C., Penn, J. E., & Kraenzle. (1998). *Farmer cooperative statistics, 1997.* Rural Development, Rural Business - Cooperative Service division, U.S. Department of Agriculture RBS Service Report 56. Retrieved December 17, 2009, from http://www.rurdev.usda.gov/rbs/pub/sr56.pdf

Sadgrove, K. (2005). *The complete guide to business risk management* (2nd ed.). Aldershot: Gower Publishing Ltd.

Sanchez-Rodriguez, C., Hemsworth, D., & Martinez-Lorente, A. R. (2005). The effect of supplier development initiatives on purchasing performance: A structural model. *Supply Chain Management: An International Journal, 10*(4), 289-301.

Sankaran, J. K., & Luxton, P. (2003). Logistics in relation to strategy in dairying: The case of New Zealand dairy. *International Journal of Operations & Production Management, 23*(5), 522-545.

Saravanakumar, V., & Jain, D. K. (2008). Economic analysis of milk production in Tamil Nadu. *Productivity, 48*(4), 408-414.

Sarkar, A. N., & Singh, J. (2006). E-enabled BPR application in industries, banking and cooperative sector. *Journal of Management Research, 6*(1), 18-34.

Sarmiento, A. M., & Nagi, R. (1999). A review of integrated analysis of production – distribution systems. *IIE Transactions, 31*(11), 1061-1074.

Schoenherr, T., Rao Tummala, V. M., & Harrison, T. P. (2008). Assessing supply chain risks with the analytic hierarchy process: Providing decision support for the off-shoring decision by a US manufacturing company. *Journal of Purchasing & Supply Management, 14*, 100–111.

Seifert, D. (2007). Efficient consumer response as the origin of CPFR. In D. Seifert (Ed.), *Collaborative planning, forecasting, and replenishment* (pp. 1-26). New Delhi: Prentice Hall of India.

Shapiro, J. F. (2001). *Modelling the supply chain*. Duxbury: Pacific Grove.

Sharma, A., & Yadav, A. (2003, August). What works: Akashganga's IT tools for the Indian dairy industry: Using IT to increase efficiency in rural dairy cooperatives. *World Resources Institute Report*, 1-19.

Sharma, M. L., Saxena, R., Mahato, T., & Das, D. (2007). Potential and prospects of dairy business in Uttarakhand: A case study of Uttaranchal cooperative dairy federation limited. *Agricultural Economics Research Review, 20*(Conference Issue), 489-502

Siegel, P. B. (2005). *Managing agricultural production risk: Innovations in developing countries*. Commodity Risk Management Group, Agricultural and Rural Development Department, World Bank Report No. 32727, Washington D.C.

Simatupang, M. T., & Sridharan, R. (2002). The collaborative supply chain. *International Journal of Logistics Management, 13*(1), 15-30.

Simchi-Levi, D., Kaminsky, P., Simchi-Levi, E., & Shankar, R. (2008). *Designing and managing the supply chain*. New Delhi: Tata McGraw Hill.

Slack, N., & Lewis, M. (2009). *Operations strategy* (2^{nd} ed.). UK: Pearson Education.

Sohrab. (2008). Major impediments in implementation of ISO 22000 in Indian dairy industry. *Indian Dairyman, 60*(4), 45-51.

Sople, V. V. (2004). *Logistics management: The supply chain imperative*. Singapore: Pearson Education.

Souviron, M. K., & Harrison, A. (2003, July). *Characteristics of supply relationships and related people management issues*. Paper presented at the International Symposium on Logistics.

Splendolini, M. J. (1992). *The benchmarking*. New York: Amacom.

Stank, T. P., Keller, S. B., & Daugherty, P. J. (2001). Supply chain collaboration and logistical service performance. *Journal of Business Logistics, 22*(1), 29-49.

Stock, J. R., & Lambert, D. M. (2001). *Strategic logistics management***.** New York: McGraw-Hill Companies, Inc.

Teng, S. G., & Jaramillo, H. (2005). A model for evaluation and selection of suppliers in global textile and apparel supply chain. *International Journal of Physical Distribution & Logistics Management, 35*(7), 503-523.

Thirunavukkarasu, D., & Sudeepkumar, N. K. (2006). Comparative profile of milk producers in different marketing systems. *Journal of Rural Development, 25*(1). 49-65.

Thun, J. H., & Hoenig, D. (2009). An empirical analysis of supply chain risk management in the German automotive industry. *International Journal of Production Economics*, 1-8. Retrieved March 5, 2010, from http://www.ijpe.org

Tiersten, S. (1989). The changing face of purchasing. *Electronic Business*, 22-27.

United Nations Food and Agricultural Organisation (2008, June). *Milk and milk products*. Retrieved November 10, 2008, from http://www.unfao.org

Van der Vaart, T., & Pieter van Donk, D. (2008). A critical review of survey-based research in supply chain integration. *International Journal of Production Economics, 111*, 42-55.

Van der Vorst, J. G. A. J., Beulens, A. J. M., De Wit, W., & Van Beek, P. (1998). Supply chain management in food chains: Improving performance by reducing uncertainties. *International Transactions in Operational Research, 5*(6), 487-499.

Vanany, I., Zailani, S., & Pujawan, N. (2009). Supply chain risk management: Literature review and future research. *International Journal of Information Systems and Supply Chain Management, 2*(1), 16-33.

Vaswani, L. K. (2008). Promoting value added traditional dairy products – Alternative business models. *Indian Dairyman, 60*(3), 118-122.

Vickery, S., Canlantone, R., & Droge, C. (1999). Supply chain flexibility: An empirical study. *Journal of Supply Chain Management, 35*(1), 16-24.

Vithal, C. P. (1986). Factors affecting milk cooperatives in Anantapur district of Andhra Pradesh: A study. *Indian Cooperative Review, 23*(4), 325-337.

Von Bertalanffy, L. (1950). An outline of general systems theory. *British Journal of Philosophical Science, 1*, 134-165.

Westgren, R. (1998). Innovations and future directions of supply chain management in US agri-food. *Journal of Agricultural Economics, 46*(4), 519-524.

Williamson, O. E. (1975). *Markets and hierarchies: Analysis and antitrust implications*. New York: The Free Press.

Zsidisin, G. A. (2003). A grounded definition of supply risk. *Journal of Purchasing and Supply Management, 9*, 217-224.

Zsidisin, G. A., & Ritchie, R. (2008). *Supply chain risk: A handbook of assessment, management, & performance*. New York, NY: Springer International.

CHAPTER III

CONCEPTUAL FRAMEWORK

In this chapter supply chain management concepts with respect to dairy industry has been discussed. The supply chain risks, coordination and performance issues are discussed in the way they are stated in the objective section of the research. Though customers are not a part of the procurement, production and distribution related issues; still their behaviour towards the product or service matters a lot for the organisations to improve. In light of this, customer satisfaction is also being discussed so as to make the study comprehensive. At the end some of the dairy food supply chain models across the world are presented to compare and contrast with the Indian dairy food supply chain.

3.1 Concepts of Supply Chain Management

Supply chain management (SCM) encompasses all the activities relating to the cost minimisation and product customisation to the customer requirement working at various levels of the organisational hierarchy. SCM manages the product, fund and information flows between and among various stages in the supply chain to maximise total supply chain profitability. A typical supply chain consists of suppliers' suppliers, suppliers, manufacturer, transporters, distributors, retailers and customers' customer and the customers at large (Chopra & Meindl, 2003). In some cases under the vendor managed inventory (VMI) the manufacturer asks the suppliers to take care of the inventory and directly supply it to the distributors and retailers. This somewhat relaxes the job of the manufacturer in the whole distribution process. Similarly some manufacturers directly ship their products to the customers' door step for final consumption and use. Companies like Dell Computers receives the orders from the customers directly, processes it and dispatch the computers and laptops etc. to them at the end. These days the supply chains are extended to countries other than the country of operation to enhance the scope through sub-contracting and outsourcing.

3.2 Supply Chain Cost and Profitability

The basic objective of a supply chain is to minimise cost and maximise profitability throughout so that every stakeholder will be satisfied and the demand be met without any breaks (Chopra & Meindl, 2003; Shapiro, 2001) The total cost may include all direct and indirect costs so that the merchandise is produced and delivered to the end users at right time (Simchi-Levi et al., 2008). Purchasing-, production- and distribution related costs play major role in the total cost calculation of a supply chain. Purchasing plays a vital role in the survival of any supply chain. Cost reduction or improvement, improved material delivery, shorter cycle time, development cycle times, access to product and process technology and quality improvement etc. could be practiced with an efficient purchasing operation in the organisation.

It has been widely seen that manufacturers spend an average of 55 cents for procurement of materials out of every dollar of revenues on goods and services (Tiersten, 1989; Monczka et al., 2002). Various activities like supplier identification, evaluation, selection, management, development, and improvement are the key issues relating to procurement process in the organisation (Monczka et al., 2002). But in most of the cases due attention is not given to the above factors and hence the procurement process becomes sub-optimal and less value additive to the supply chain.

According to Reck and Long (1988) as cited in Cousins et al. (2008), "there are four different stages in the development of a purchasing function viz. passive, independent, supportive and integrative". In case of an independent supply chain the primary focus is to reduce costs and maximise profits unlike a passive supply chain. In supportive and integrated supply chain the basic priority is on the purchasing strategy and is dealt with a strategic object unlike independent and passive supply chains.

The supply chain cost is the total cost incurred in the supply chain starting from the suppliers' supplier to the customers. According to Supply Chain Operations Reference (www.supply-chain.org), supply chain cost is the total cost associated with the plan, source, make and deliver decisions. In this study also all the costs are taken into consideration except the cost of planning since this is not known. Hence the study will be discussing the costs related to procurement, production and distribution.

The dairy industry which is highly diverse and heterogeneous starts with a village level milk producer (supplier) and ends with the customers in the urban areas. The optimum level milk productions at the farmer level (Barman et al., 2008) can possibly decrease the cost of production (Prasad, 2005) as well as the total cost of the supply chain. Due to the lack of optimal production the milk producers are incurring losses and hence to some extent leaving the avocation. This not only brings down problems for them rather decreasing the gross domestic product (GDP) from agriculture over a period of time. So in order to have a sustainable development in dairy industry (Khanna, 2005) it is highly essential to increase the farm level milk productions.

Moreover the non-remunerative price of the cooperative based dairying (Rajgopal, 1996; Kohl et al. 2002), the situation becoming terribly affected leading to low participation of the milk producers in the system. The lack of milk production also has serious repercussions at the downstream members of the supply chain. The cost of collections and the chilling (Rangasamy & Dhaka, 2007) respectively with the dairy cooperative societies and the bulk milk coolers keeps on rising due to low milk procurements. Sub-optimal level of procurement further increases the cost of transportation and processing (Rangasamy & Dhaka, 2008). That's the reason why an efficient milk procurement system could minimise various supply chain costs.

3.3 Types of Supply Chain

Supply chain management is defined as the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole (Mentzer et al., 2001). Depending upon the nature of the products/services the supply chain is designed. There are five different types of supply chain discussed below.

- **Lean supply chain:** The lean supply chain is the supply chain which aims at reducing or eliminating the wastes by aligning automation and just-in-time approaches (Womack & Jones, 1996; Ohno, 1988). In 1988 the concept has been propounded by Ohno at Toyota Motors to eliminate or reduce wastes through value-added activities while making the product reach the end users at the right time and right location.
- **Agile supply chain:** The supply chain which responds the market rapidly when the demands are highly volatile and not known (Christopher & Towill, 2000). This type of supply chains are suitable for the dairy industry where the demand is sporadic and is based upon the availability. The profit margins are also comparatively higher.
- **Leagile supply chain:** This kind of supply chain is lean at the upstream while being agile to the downstream aiming respectively at cost effectiveness and high service level (Mason-Jones et al., 2000). For an instance hotel industry or dairy industry – the upstream side is lean while the downstream side is agile. In the former part the waste

reduction is the objective while in the latter part the service level to the customers are extremely important.

- **Resilient supply chain:** The supply chain which can operate in an uncertain business environment thus increasing its ability to cope up with the risk (Tang, 2006). The supply chain risks and uncertainties are quite common which disrupt the supply chain or reduce profit. In order to operate in a very risky or uncertain environment it is essential to increase the risk coping efficiency of the stakeholders.
- **Green supply chain:** This kind of supply chain aims at reducing the ecological risks being created by it while achieving the corporate profits and market share objectives (Zhu et al., 2008). Global warming, sporadic changes in the climate and environmental pollutions are compelling the organisations to take care of the environment as a whole by reducing carbon foot prints. The green supply chain though not specifically pertains to an industry still it is for all kinds of it to be followed on moral grounds as a corporate responsibility.

According to Mason-Jones et al. (2000) the basic distinctions between the lean and agile supply chains are as depicted below:

Table 3.1: Lean vs. Agile supply chain

Distinguishing attributes	Lean supply chain	Agile supply chain
Typical products	Commodities	Fashion goods
Marketplace demand	Predictable	Volatile
Product variety	Low	High
Product life cycle	Long	Short
Customer drivers	Cost	Availability
Profit margins	Low	High
Dominant costs	Physical costs	Marketability costs
Stock-out penalties	Long-term contractual	Immediate and volatile
Purchasing policy	Buy goods	Assign capacity
Information enrichment	High desirable	Obligatory
Forecasting mechanism	Algorithmic	Consultative

Source: Mason-Jones et al. (2000)

The choice of supply chain depends upon the nature of the product. If the product is durable or semi-durable and the demand is predictable then probably a lean approach could be the solution but when the product or the raw material is perishable and the demand is highly unpredictable and supply is a constraint then an agile approach is the solution to perform better. The above table depicts the practices to be made in case of both the supply chain types. For an instance for a dairy product the demand is very high then procurement should be based on the assignment of capacity to the suppliers and forecasting should be done with due consultation with the stakeholders in the system (Mason-Jones et al., 2000). It is seen that for this case demand is highly unpredictable and the supply is comparatively lesser than the demand. Other distinguishable differences have been depicted in the table above which fits for the products depending upon their nature and market conditions.

3.3.1 The relationship between supply chain types and attributes

Table 3.2: LARG versus synergies and divergences

Paradigms / Supply chain attributes	Lean (L)	Agile (A)	Resilient (R)	Green (G)	
Information frequency	↑	↑	↑	-	*Synergies*
Integration level	↑	↑	↑	↑	
Production lead time	↓	↓	↓	↓	
Transportation lead time	↓	↓	↓	↓	
Capacity surplus	↓	↑	↑	↓	*Divergences*
Inventory level	↓	↓	↑	↓	
Replenishment frequency	↑	↑	↑	↓	
Legend: ↑ increase; ↓ decrease; - without consequence;					

Source: Carvalho and Cruz-Machado (2008)

Information frequency and level of integration increase in all the above supply chain types. In other words it can be said that information frequency and level of integration are required to be higher irrespective of nature of the supply chain. Production and transportation lead times are also decreased in all the supply chains which are the basic functions of supply chains irrespective of their nature. In lean and green supply chain the capacity surplus decreases or is required to be less whereas in the agile and resilient supply chains this is required to be higher and hence increases. Except the resilient supply chain in all other kinds the inventory level decreases and in the similar way except for the green supply chain the replenishment frequency increases to fulfil the demand and maintaining a high fill rate.

3.4 Role of Purchasing in Supply Chain

Purchasing plays a vital role in any supply chain operations. The higher is the purchasing the higher is the role of a purchasing manager and higher is the amount money invested to procure material from various sources. The history of purchasing could be as old as 200 years old and sourced from the Railroad companies in the US (table 3.3). The evolution of purchasing over this period has been mentioned in the table below till it is being treated as a strategic function than a clerical one.

"There may not be one best way to source; one should investigate the nature of business environments before making strategy decisions."

Murray, Kotabe and Wildt (1995)

Table 3.3: History of purchasing

Period	Duration	Evolution stage
The early years	Early 1800 - 1900	Railroad companies in the US treated purchasing a major function and gave it a separate department status.
The purchasing procedure refining years	1900 - 1914	Purchasing procedures were refined and considered as a clerical activity.
The war years (WW I-WW II)	1914 - 1945	Importance of purchasing increased due to the requirement of war materials. Mass production by Ford made it an important function.
The quiet years	Late 1940's - mid 1960's	Purchasing function became better refined as the number of trained professionals increased.
The age of material management	Mid 1960's - early 1980's	MRP introduced which later on evolved to MRP II and JIT emphasising on supplier relationships. Purchasing evolves to procurement during this period.
The age of globalisation and e-commerce	Late 1980's - 2000	Due to advancement of internet- B2B, B2C and C2B became new transaction models. Supply network expanded to global market.
The age of integrated supply chain management	2000 and beyond	Increasing integration with supply network and information technology.

Source: Li (2007)

3.4.1 Stages of Purchasing

It has been experienced that more than half of the supply chain cost is incurred towards purchasing various items/materials (Tiersten, 1989; Monczka, 2002) in the industry. Hence these days many organisations are linking their purchasing to strategic decisions. According to Reck and Long (1988) as cited in Cousins et al. (2008) there are four different stages in the development of a purchasing function viz. passive, independent, supportive and integrative.

Stage I: Passive: In this case the purchasing function has no strategic direction and primarily reacts to the request from the other functions. In this stage the corresponding department does not have much contribution except performing the regular activities in the firm. The purchasing managers mostly deal with the supply related problems. The basic characteristics of the purchasing department at this stage are:

- High proportion of time spent on quick fix routine operations
- Purchasing function and individual performance based efficiency measures
- Little inter-functional communication due to low visibility of purchasing in the organisation
- Supplier selection based on price and availability

Stage II: Independent: Purchasing function here adopts the latest purchasing techniques and practices but its strategic direction is independent of firm competitive strategy. At this stage the primary focus of the firm is to work with greater efficiency. The main characteristics of the purchasing function are:

- Performance is primarily based on the cost reduction and efficiency measures
- Coordination links between purchasing and technical disciplines are established
- Top management recognises the importance of professional development
- Top management recognises the opportunities in purchasing for contributing to profitability

Stage III: Supportive: In this stage the purchasing function supports the firm's competitive strategy by adopting purchasing techniques and products, which strengthen the firm's competitive position. Top management deals the department as an essential business function to the firm. The department provides necessary support and information to all other departments to deal with pricing and material related problems. The characteristics of supportive stage are as mentioned hereunder:

- Purchasers are included in sales proposal teams
- Suppliers are considered a resource, which is carefully selected and motivated
- People are considered a resource, with emphasis on experience, motivation and attitude
- Markets, products and suppliers are continuously monitored and analysed

Stage IV: Integrative: Purchasing strategy is fully integrated into the firm's competitive strategy and constitutes part of an integrated effort among functional peers to formulate and implement a strategic plan. At this stage, the purchasing department works proactively which minimises the potential threats. The basic characteristics in this case are:

- Cross-functional training of purchasing professionals and executives is made available
- Permanent lines of communication with other functional areas are established
- Professional development focuses on strategic elements of the competitive strategy
- Purchasing performance is measured in terms of contribution to the firms' success

3.5 Concepts of Logistics

The word logistics derived from the Greek word "Logistikos" and the Latin word "Logisticus", which means the science of computing and calculating. It was first used by the French army during 17th century. After the World War II, the US army officially used the term "logistics" which is defines the physical distribution of materials and finished goods from one place to another.

The American Council of Logistics Management defines logistics as, "the process of planning, implementing and controlling the physical flows of materials and finished goods from point of origin to point of use to meet the customer's need at a profit". It covers various functions like order processing, inventory management, warehousing, transportation, material handling and storage, packaging etc. under a proper information sharing base.

As said in the below given table 3.4 the distribution related cost is almost two third of the total logistics costs and hence is highly crucial for the entire system. The prudential planning of the transportation functions and travelling-salesman related issues should be undertaken and implemented in the supply chain to curb the logistics costs. For a typical dairy farm the distribution of milk to the retailers and industrial customers like hotels and restaurants are judiciously carried out so that the perishability in the process can be curbed and while minimising the distances travelled en-route.

Table 3.4: Logistics costs breakup

Stages	Cost items	Share in logistics cost (percent)	Cumulative share of stages (percent)
In-bound logistics	Transportation	12.0	28.0
	Storage	8.0	
	Inventory	8.0	
Process logistics	Transportation	2.0	7.0
	Storage	5.0	
Out-bound logistics	Transportation	33.0	65.0
	Storage	15.5	
	Inventory	6.5	
	Order processing	10.0	
Total	-	100.0	100.0

Source: Sople (2004)

Sometimes injudicious planning of the routes brings harm to the products and leads to customer dissatisfaction. In-bound logistics constitute 28 percent or almost less than one third of the logistics costs. It is noted here that for a perishable product like liquid milk inventory is maintained to be very high unless it is UHT milk which can be stored for 2-6 months without damage. But for pasteurised milk and other susceptible dairy products to damage are not much stored and hence produced according to the tentative demand (agile supply chain behaviour).

3.5.1 Transportation

It is the process of moving objects from one place to the other; being most important factor of logistics. There are several modes of transportation viz. road, rail, sea, air and pipelines. Out of all these, road medium is the most advantageous method of transportation because of its high reachability and flexibility. Currently in India there are 25 million trucks operating in the logistic sector with average distance coverage per day is 250-300 kms against 550-600 kms in the developed countries. The average operating cost of an Indian truck is Rs.15 per km (Sople, 2004). Various factors, that affect the operating/freight costs are:

- Volume (sub-optimal lot size, under optimal unit leads to higher per unit cost)
- Distance (the more the distance the more the cost)
- Product density (wt/volume, low density products brings up cost e.g. wool, cotton)
- Product shape (irregular shape needs careful driving and leads to more fuel burn)
- Product handling (needs crane, forklift trucks, earth movers, which increase the unit cost)
- Product type (perishable products like milk need conditioned transportation)
- Market dynamics (sometimes the freight charges are fixed by the associations)

Vijayaraghavan (2001) as said in Sople (2004), 84.3 percent of firms have been using outsourced transportation where as the rest 15.7 percent use in-house mode of it. The logistics function in the organisations is one of the key function areas which require expertise in the field. But it is found that most of the organisations do not have the proper skill to deal with the function that’s the reason why the activity has been outsourced to other parties which have the expertise in it. Some of the advantages of the outsourced logistics are:

- Cost reduction
- Wide coverage
- Resource optimisation
- Optimising customer satisfaction
- Enhancing core competencies

3.6 Major Supply Chain Challenges

Had it been changing demand pattern or competition in the market place, there exist challenges for the supply chain. These challenges could be:

3.6.1 Increasingly demanding customers

The demands are more rampant and dismantled in case of manufacturer as a customer of raw materials and components or the end users of a final product. Whereas manufacturer demands improvement in delivery lead time, cost and product performance from the suppliers; the end users demand low price, better quality and faster delivery etc. from the manufacturer. If the suppliers won't work up to the expectations of the manufacturer then the contract with the earlier suppliers are broken and new suppliers are searched and contracted. On the contrary, keeping view to the end users product proliferation is very common practice today. It gives rise to shorter Product Life Cycles (PLC) of many products which in turn incurs heavy costs affecting the responsiveness within the supply chain.

3.6.2 Fragmentation of supply chain ownership

Off-shoring, outsourcing and sub-contracting of many non core activities has been a very common practice in the manufacturing industry. Wherever this has brought a tremendous change in the sector for getting globalised but at the same time the companies are losing control over the supply chain. The whole supply chain is fragmented with many owners who work with their own policies and interest giving rise to conflicts in many occasions and decrease in the overall supply chain profits and revenue.

3.6.3 Globalisation

Globalisation has given rise to steep competition among the various players in the market. Since more and more companies are interested in the global marketing so the supply chains are becoming larger but it is extremely difficult to coordinate. Globalisation and free trade has brought sea changes in the business where distance is not perceived as a problem rather it is used to the fullest capacity in anticipation of low price material/product/labour and timely delivery of the same.

3.6.4 Difficulty in executing new strategies

Strategies are easy to formulate than to execute. Whether it is related to the product customisation, outsourcing or supplier autonomy, high risk is intact everywhere and companies are finding it hard to execute though not impossible. Further there are several stakeholders for the supply chain and keeping track of every stakeholder and coordinate them accordingly is found to be difficult. Vested interest of the stakeholders in the system also brings harm in a guised way. For an instance in dairy industry the milk producers in the rural areas try to sell their produce themselves in the nearby markets but when they become failure in the process resort to the cooperative societies in anticipation of selling with other guised motives – difficult to know. Moreover a strategy undertaken might not be advantageous to all the stakeholders which sometimes bring up conflicts.

3.7 Supply Chain Risk Concepts

Supply chain management is gaining overwhelming response from across the world irrespective of the type of industry and supply chain (Li et al, 2006) and so is supply chain risk management (Faisal et al, 2006b; Tang, 2006a). It is the most comprehensive approach which entangles all the stakeholders in the system to make the product or the service available at least cost and with maximum customer satisfaction. But in order to have an efficient and effective supply chain in the long run, it is highly essential to identify and mitigate the risks and uncertainties. Risk and uncertainty, though used interchangeably in various studies, are not same. Wherever in case of risk the probability is known, it is not known for the uncertainty (Siegel, 2005). Risk and uncertainty has always been an important issue in supply chain management and is wide-spread. Under the purview of supply chain management there is a little scope for the stakeholders to get rid of these issues. Every stakeholder in the system has its own working environment where the vulnerabilities are quite common and frequently come into being by disrupting the dyadic links.

Earlier the risks and uncertainties in the supply chain were dealt as company-specific tasks (Juttner, 2005) but later on it was realised that, since the supply chain is a complex bonding of several stakeholders, distortion at one of the components distorts the entire system by varying degrees. For an instance, in case of organised dairy food supply chain, "non-remunerative price to the producers" at the producer-cooperative society dyad brings down the procurement of milk at plant level which in turn increases the price of the products. The producer, who gets a non-remunerative price for the produce shows dissatisfaction and gradually losses his/her confidence on the performance of the chain. If this happens to be a case for a long time he/she sells out his cattle and gets abstinent from producing milk anymore. If a few producers in the system do the same, it may not necessarily affect the flow of the chain. But if followed by thousands of the producers then it definitely brings down the procurement throughout the upstream supply chain.

The low procurement of the material at the production plant seriously affects the production processes. Since the products are not produced at optimum level and distributed to the retailers on time, both the retailers and the customers get dissatisfied. This not only hampers the flow of the chain but also snatches the avocation of the poor milk producers creating serious problems in the society. Clearly, if a single component of the chain gets violated, it affects the entire supply chain's flow. Though the supply chain risks and uncertainties are quite rampant still in many cases a proper risk redressal mechanism seems to be lacking. Of late, the research and development in this respect is gaining its momentum and has become a top agenda for both researchers and practitioners (Vanany, Zailani, & Pujawan, 2009; Thun & Hoenig, 2009).

3.7.1 Risk management

"When our world was created, nobody remembered to include certainty" (Bernstein, n.d).

The famous quote by Bernstein indicates the uncertainties and risks in the worldly phenomena. Risks and uncertainties are inevitable no matter how strong is the individual or institution in making decisions. These often come into the picture with some sort of unpleasant results with them. It is not only difficult to predict the outcomes of the events rather it is also difficult to avoid them in many real life situations. So a clear-cut risk redressal mechanism is the call for the day to minimise the impact irrespective of the organisation. In this connection the supply chain of farms are no deviations. The supply chain makes the products or services available at the market place with least cost and maximum stakeholder satisfaction. Redressing/managing risk is essentially a major task for the smooth functioning of any supply chain.

Every supply chain, irrespective of its type, invariably attached to the risks and uncertainties. The risks could be of different types depending upon its impact on the supply chain. They are viz. high risks, medium risks and low risks etc. A "high risk" affects the supply chain drastically and obstructs its efficiency unlike medium and low risks. Though all medium and low level risks can't be fully ruled out from the hierarchy of risks still some organisations have the flexibility to overlook them. On the contrary, the highly efficient supply chains have either lower risks or more capability at their disposal to handle the risks and uncertainties (Nicholas, 2001). The high degree of efficiency in detecting and mitigating risks could be attributed to the experience gained from past years and the coordination among the supply chain stakeholders.

Managing the supply chain greatly depends upon the risk management efficiency of the firm. Today in the era of globalisation, organisations not only face stiff competitions in the market place rather confront whole lot of difficulties aroused from the operation - may be related to supplier management, production management or logistics management. Each part of the supply chain is vital and needs diversified expertise. The problems being evoked from all sort functions in the organisation may be brought under the purview of risk management. Of late organisation come to realise that the risk management is a part of the operations management and hence has been viewed seriously these days. Various authors have described risk management in one way or the other but the most comprehensive definition have been suggested by the Australian Standard 4360 (1995).

Australian Standard 4360 (1995), as said in Frost et al. (2002) has defined risk management and risk in the following ways which has been considered by ISO as a basis for an international standard:

> The chance of something happening that will have an impact upon objectives. It is measured in terms of consequences and likelihood. Risks are uncertain future events which could influence the achievement of the organisation's objectives, including strategic, operational, financial and compliance objectives. (2002, p.27)

3.7.2 Types of risk

There are basically four types of risks. They are operational, strategic, compliance and financial risk. Operational risks are the risks related to the production and operation function in the organisation like problems related with production process, distribution and logistics related hazards etc. whereas strategic risks are the risks experienced at the higher level like competition in the market place, technology, collaboration related difficulties etc. Further changing government rules and regulations, political hindrances etc. can be attributed to the compliance risks and exchange rate fluctuations, credit risks and lack of profitability etc. come under the financial risks. In this research focus is basically concentrated on the operational and financial risk issues. The various problems discussed in the introduction chapter are further modified to define the risks and uncertainties at each level of the supply chain. Starting from the milk producers in the rural areas to the consumers in the urban areas the detailed discussion upon this issue has been made. There are several reasons for the risk management process to be undertaken in the organisation of which some of the major reasons could be:

- ❖ Rapid globalisation
- ❖ Internal competition
- ❖ Increased risk awareness
- ❖ Increased regulation
- ❖ Demand unpredictability
- ❖ Enhanced consumer awareness
- ❖ Scarce resources and so on t name a few

3.7.3 Benefits of risk management

Benefits of risk management are manifold as it can help the organisation to take new opportunities by optimising the risk and the return. Moreover it helps the organisation to avoid cost, disruption and unhappiness (Sadgrove, 2005). However the benefits among others could be but not limited to:

- Enhanced overall growth
- Higher profit margin
- Improved cash flow
- Decreased loss due to depreciation
- Increased stakeholder satisfaction
- Reduction of causalities
- Enhanced supplier efficiency

3.7.4 Risk management process

The risks management process starts with a problem definition and ends with the action. The various steps of the risk management process are discussed hereafter (figure 3.1).

Step I: Define risks

A "risk" is nothing but an event with known probability which brings out an unpleasant result. It could be a potential damage or loss to the farm which affects the supply chain negatively. The British Standards Institute defines, "risk as a combination of probability or frequency of occurrence of a defined hazard and magnitude of the occurrence" (BS 4778, 1991, as stated in Schoenherr et al., 2008, p. 101).

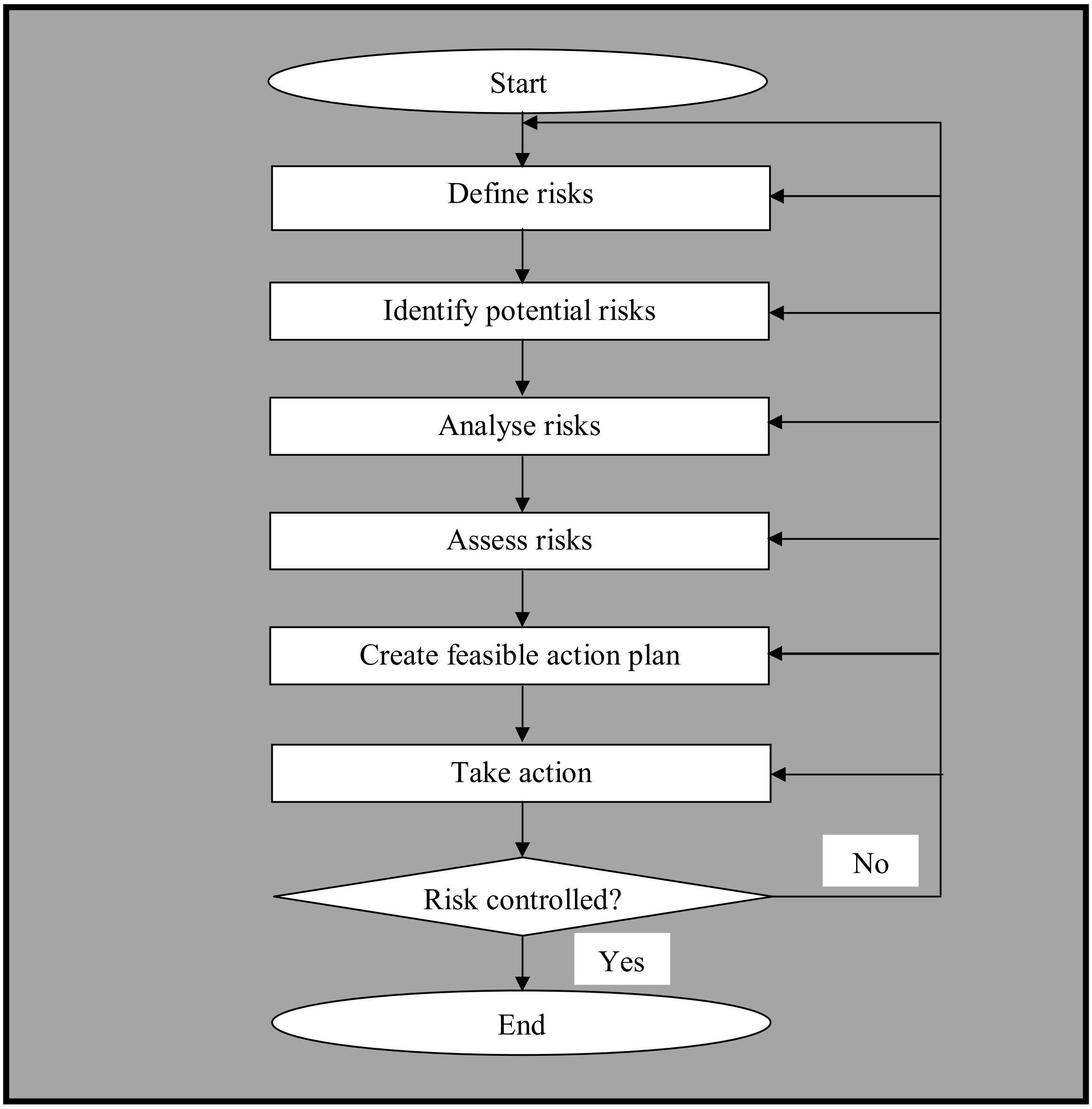


Figure 3.1: Flow chart of risk management process

The two if unaddressed for a long time might defunct or break down the links in the supply chain. But a major task here is to define the risks and uncertainties for the entire supply chain, which is though not impossible still not an easy affair to deal with. It requires a great deal of past experience in the industry concerned and a team with high expertise in the field. According to the opinions of the experts and the past history of the supply chain – risks and uncertainties could be defined in an organised manner. The risks and uncertainties for various supply chains may be perceived differently. A risk or uncertainty for a particular supply chain in any industry may not be necessarily the same for other supply chains always. It all depends upon the organisational set up and it's working environment.

Step II: Identify risks

Risk and uncertainties are inevitable for any type of supply chain. But it is imperative for the chain to identify the risks and take action to control them successfully. Some of the risks are easy to detect and some are not. The identification process could start in many ways. It could be a survey where the stakeholders' opinions are taken and assessed, brainstorming, checklist or work breakdown structure (WBS) at the organisation level etc. to generate exhaustive list of the problem areas.

The risks are of two types- namely; internal risks and external risks. Internal risks arise from the organisation itself whereas the external risks are attributed to the outside world of the organisation. The internal risks could be namely; financial risks, technical risks, supply risks and logistical risks etc. whereas market risks, political risks, hazard risks and natural calamities etc. are some of the external risks. While identifying the various risks, both internal and external risks should be considered logically.

Step III: Analyse risks

Any risk or uncertainty is basically related to two major factors viz. likelihood and the severity (Mulacahy, 2003). Likelihood is nothing but the chance or the probability that the event occurs whereas severity is attributed the degree to which it causes damage to the supply chain. These two different entities contribute to the impact of the risk on the supply chain. Undoubtedly, the higher degrees of all these factors cause a major damage leading to supply chain breakdown. Though it may be difficult to generalise the correlations among the variables still there is no hesitation to say that, any event with higher probability and severity might bring in supply chain failure and disruption. So risk is treated to be varying over probability and severity. Mathematically:

Risk = f (Likelihood, Severity);

If, Likelihood (Probability) = P, Severity = S then Impact (I) = P * S;

P: 1 = very low (0.0-0.2), 2 = low (0.2-0.4), 3 = medium (0.4-0.6), 4 = high (0.6-0.8), 5 = very high (0.8-1.0);
S: 1 = insignificant, 2 = minor, 3 = neither serious nor minor, 4 = serious, 5 = catastrophic;

I: 1 = very low (1-5), 2 = low (5-10), 3 = medium (10-15), 4 = high (15-20), 5 = very high (20-25).

It is clear that the risk impact values range from 1 through 25 under a five point Likert scale. Whereas "1" indicates a very low risk, the value "25" indicates high risk pertaining to a particular event. In this case, there can be 25 such permutations out of which the extreme left and the right values indicate "very low" and very "high risks" respectively. The values ranging from 1 through 25 could be further scaled down to put in the five point rating scale as mentioned in the table. Keeping view to the likelihood and the severity of the various risks – the risks can be with the following symptoms:

(i) High probability and high severity;
(ii) High probability and low severity;
(iii) Low probability and high severity and
(iv) Low probability and low severity.

Step IV: Assess risks

The risks in order of the descending "impact" values could be arranged in a list so as to identify the high risks, medium risks and the low risks etc. in the supply chain. Undoubtedly the high risks are the most prioritised areas where decisions need to be taken as early as possible in the supply chain so as to minimise their intensity or to stop the supply chain breakdown. For similar kind of high risk activities or events the organisations have to decide the case where to take action first, when and how? This is usually based upon the stand of the organisation in dealing with the particular risk in the yester years. Brainstorming in this regard is also a technique which usually addresses these impasses. The decisions are taken based on the available resources of the organisation concerned.

Step V: Create a feasible action plan

The action plan meant to find a tentative solution for the risks and uncertainties. While creating the action plan feasibility conditions of the same should be considered. There are risks with high, medium or low impacts based upon their impact values. The impact variability is quite subjective in nature and based upon the risk tolerance of the concerned organisation. The above values in the table are based upon the field-expert opinion and the survey conducted by the researcher in this case. The values and the ranges depicted might vary with respect to the industry concerned. Based on these impact values, the risks and uncertainties are given importance in the supply chain to be addressed. The organisation has to decide which of the risks are to be transferred to other parties and which are not. Can a particular risk be simply avoided or ruled out for the entire chain? Can a particular risk be reduced or mitigated so as to minimise the impact of it on the chain?

Step VI: Take action

Decisions are implemented to mitigate or reduce the risks and uncertainties. But all the decisions implemented might not work as expected indicating flaws thereto. In this case the process needs to be thoroughly monitored and controlled and a suitable strategy again formulated to address the problems. Decision making in this case will be easier when it is consulted with other stakeholders in the system. Sometimes in a supply chain decisions or strategies taken without the consultations with the concerned stakeholders lead to discontentment and conflict. Hence it is important to take the decision and action against a risk or problem with due consultations with the stakeholders. In this way a collaborative working environment can also be developed and risks could be minimised.

3.8 Supply Chain Coordination

Supply chain coordination is the mechanism by which the stakeholders take action together so as to enhance the overall supply chain profits (Chopra & Meindl, 2003). The supply chain which is the combination of several stakeholders in the system consider the actions taken at each individual interfaces so that the conflicts arising out of it can be resolved. It has been seen many a times that the stakeholders keep interest in their own operation and won't consider its impact upon the other stages of the supply chain. This not only decreases the overall profit rather invites the bullwhip effects in the supply chain which might worsen the relationships among the supply chain partners.

3.8.1 Causes of lack of supply chain coordination

There are so many issues of supply chain coordination failure. The critical issues in this case are:

- Lack of trust
- Lack of infrastructure
- Lack of information sharing
- Non-involvement in the decision making

- Low profit

3.8.2 Patterns of collaboration

Collaboration in a supply chain can be practiced in so many ways – may be outsourcing of decision making or capacity sharing etc. The various types of collaboration along with their practices have been depicted in the table 3.5:

Tables 3.5: Patterns of collaboration

Type	Practice	Examples of practice
Outsourced local decision making	Increase the level of responsibility of suppliers	Vendor managed inventory, supplier quality programme, early supplier involvement (component design)
Improved local decision making	Enhance and align local decision making	Information sharing, shared POS data, joint capacity management and joint inventory management
Decision objective alignment	Joint objective planning and objective alignment	Collaborative forecasting, collaborative promotion planning, early supplier involvement and category management
Pooled resource and capacity sharing	Resource pooling and sharing and joint decision investment	Shared pallets, joint trailers, 3PL (mediated resource sharing), joint facility and R&D investment, shared prototyping facility
Process and information system integration	Business process and information system integration	JIT supplier (such as Toyota), CPFR standards adoption, B2B market place, E-business standards compliant
Supply chain process reengineering	Internal business process redesign and alignment	Joint cycle time reduction, supply chain event management, suppliers training and evaluation, process postponement, performance metrics

Source: Frayret (2002) as said in Karuranga et al. (2008)

Arshinder, Kanda and Deshmukh (2008) have suggested that, stakeholders in the supply chain should work towards a unified system and coordinate with each other in order to face challenges. According to them integration, cooperation and collaboration are all part of supply chain coordination and complementary to each other. Based on the gaps from the literature they have proposed the below given model to quantify the supply chain coordination index (SCCI). Supply chain contracts, information technology, information sharing and joint decision making play key roles in the overall supply chain coordination.

The overall performance of the supply chain coordination can be measured on the basis of weightage give to these indicators along with their values as opined by the stakeholders.

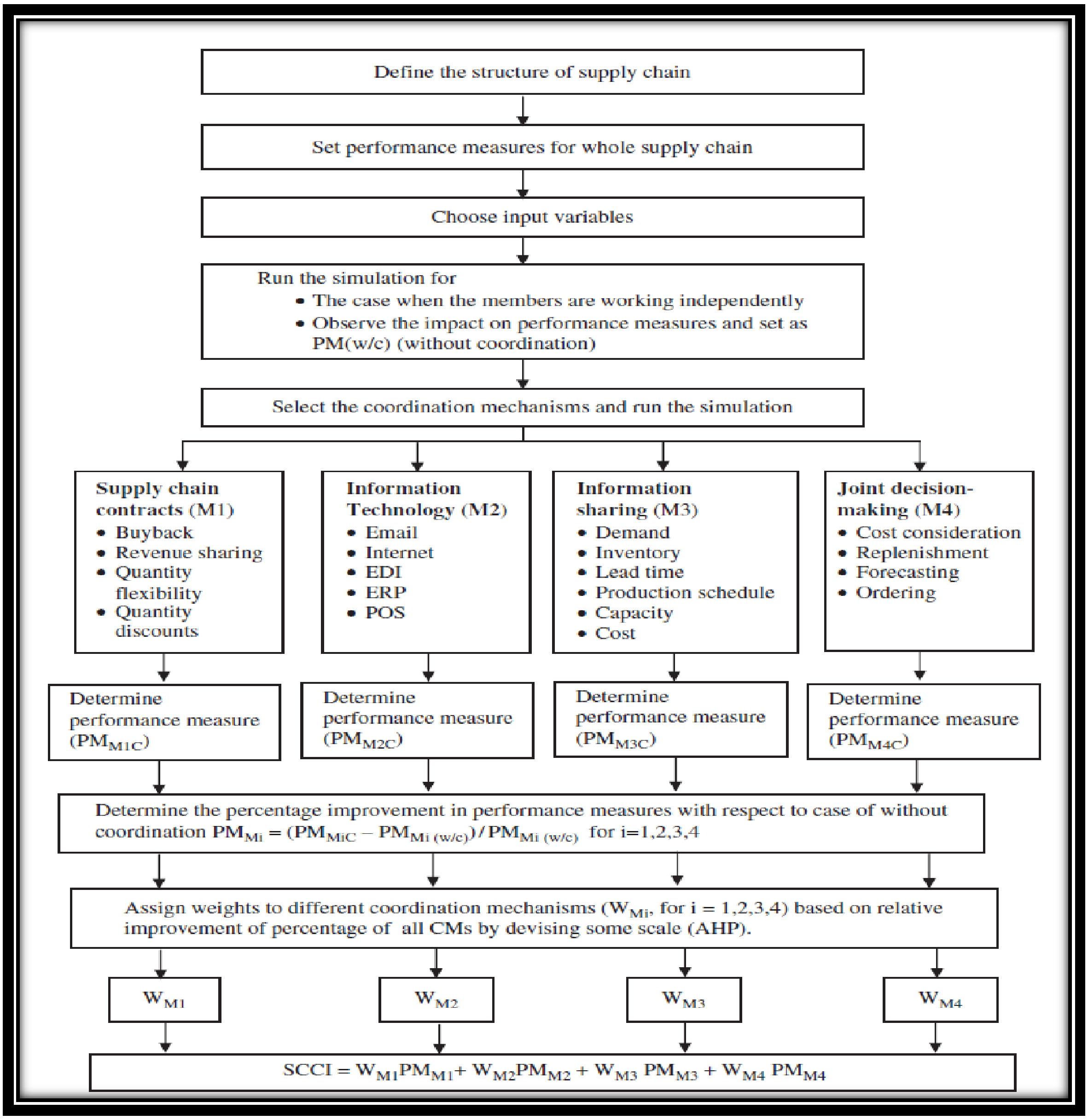


Figure 3.2: Measuring supply chain coordination (Source: Arshinder et al. (2008))

Supply chain relationships should be viewed from both buyers' and suppliers' perspectives while considering collaborative relationships. The collaborating relationship depends upon long term relationship (Krause, 1997), information sharing (Pyke et al., 2000; Monczka et al., 2002; Nyaga, Whipple & Lynch, 2010) and team work.

The work done by various researchers indicates that collaborative activities such as information sharing, joint relationship effort (Ellinger, Daugherty, & Keller, 2000; Nyaga et al., 2010) and dedicated investments (Rinehart, Eckert, Handfield, Page, & Atkin, 2004; Nyaga et al., 2010) lead to trust and commitment (Moberg & Speh, 2003) which further lead to improved satisfaction and performance (Dahlstrom, McNeilly, & Speh, 1996; Knemeyer, Corsi, & Murphy, 2003; Kauser & Shaw, 2004; Johnston, McCutcheon, Stuart, & Kerwood, 2004). While buyers focus on relationship outcomes, suppliers found to safeguard their transaction specific investments through information sharing and joint relationship effort.

3.9 Supply Chain Performance

Determining the variables for measuring performance of the key stakeholders of a typical dairy food supply chain has been extremely difficult. Some of the measures studied from the existing literature (Beamon, 1999a; SCOR, 2000; Gunasekaran et al., 2004; Aramyan, 2007) have broadly used indicators like efficiency, flexibility, responsiveness, innovativeness, product quality and process quality with varying degrees. More or less all the authors or institutions have focused on cost, quality, time and innovativeness which are later brought under the purview of the above indicators. After coming across through a series of studies and research papers, three broad indicators have been considered in the study to make it more precise and appropriate. They are namely;

- Supply chain indicators
- Customer satisfaction index
- Risk coping efficiency of partners

The below mentioned discussions are all about the supply chain indicators namely efficiency, flexibility, responsiveness, product quality and process quality. Even though product quality depends upon the process quality to some extent still it is considered to demonstrate the dimensions according to the scale developed by Aramyan (2007).

3.9.1 Efficiency - in terms of cost and profit

Efficiency of a firm is measured in terms of cost and profit. If the cost is higher than the sales then there is no scope for profit and hence the return on investment is negative or low. Under the efficiency head facility cost, transportation/transaction cost, inventory cost and the return on investment (ROI) are considered by giving due weightage to their suitability to a particular component. At the milk producer level the facility costs are measured in terms of cost of milk production where the fixed and variable costs are taken into consideration to calculate how much money is put in the process to produce one litre of milk. Since the milk producers stay within 2 kms radius of the dairy cooperative society (DCS) the scope for incurring transportation cost is ruled out. The preferred mode of transportation in their case is either walking or cycling. Inventory cost is also not an applicable parameter because the milk produced by them is delivered in specified time to the cooperative societies.

For the DCS and BMC the facility costs are treated to be respectively the collection and chilling costs where the fixed and the variable costs are considered. Sometimes in the spreadsheets the depreciation of fixed assets has been taken into consideration. Here in both cases there is no scope for the inventory - due to very nature of perishability of milk it is hardly kept preserved at a certain stage. Even though it is stored for sometime at the BMCs after chilling it is insignificant except emergency cases. Both the in-bound and the out-bound transportations are taken care by the union on behalf of BMCs is found to be a significant cost. This is the apex organisation which is responsible for the procurement process.

For the production plant, the facility cost includes the various costs associated with procurement, "production and processing" and distribution. At this stage the inventory cost has been taken into consideration even though cost incurred on finished goods inventory is lower than the raw material inventory. Among the raw materials poly packs, SMP, sugar, chemicals and other durable/semi-durable articles/materials are crucial and the inventory cost is basically calculated on them. Except the cost of processing of milk no other product costing is shared with the researcher. Based upon some literature and evidences from the cost of processing milk the items are concluded. According to the officials the costing is a susceptible issue and is basically not shared with outsiders. With great difficulty the costing of milk processing template has been obtained and made inferences thereto.

Transporting agencies both fixed and the variable costs are taken into consideration where the basic investments are on the vehicles and costs incurred towards making the vehicles insulated/air conditioned to deliver the products without damage to the retail outlets. In their fixed costs, are like one time investment and the variables costs are the operating and trip related costs.

For the retailers various costs which are incurred to make the sales possible are undertaken. Inventory and transportation related costs are found insignificant in their case. The ROI factor has been carried forward to measure financial performance of every stakeholder. Since the ROI is equal to the profit made throughout the year upon the investment in the business so in order to avoid redundancy only former is kept on roll.

3.9.2 Flexibility - the ability to change under a certain circumstance

In this aspect, customer satisfaction, delivery flexibility, volume flexibility, fill rate, back order and lost sales are taken into consideration. While customer satisfaction has got its usual meaning, delivery flexibility refers to the ability to change the delivery dates/times according to the requirement of the downstream and upstream members in the supply change.

In contrast, the volume flexibility refers to the level of production/procurement/supply according to the need of the other members in the supply chain. In some cases while delivery flexibility has more importance in other cases volume flexibility is very useful even though both the concepts important. Back orders and lost sales are concepts which occur during the stock out situations. Back order is nothing but the amount of material which is not delivered as per the order of the customers but promised to be delivered when stock is available. Lost sales is the stock-out situation which refer to the market lost or demand lost during this period and there is no scope to fulfil the demand some other point of time.

In this particular discussion the whole procurement chain is out of scope of customer satisfaction as the downstream members are bound to purchase their produce or procurement. But for the production plant, retailers and the transporters it is vitally important since the concerned purchasing member has got a choice to shift for other avenues.

The production of milk almost inflexible in the quantity and hence the volume is largely fixed which flows downstream. But the delivery system is bit flexible and hence the members do not hesitate to be abided by the change in delivery timings. For the retail outlets, production plant and the transport agencies it is extremely important to assess the quantity of products they can handle to manage the distribution chain. Except for the production plant and the retail outlets back orders and the lost sales are immaterial for others since there is no scope of stock-ins and stock-outs.

3.9.3 Responsiveness – the ability to react to a certain circumstance

Fill rates, lead time, customer response time and customer complaints are the parameters used to measure the responsiveness in the supply chain. Fill rate is a crucial factor which is mostly used for measuring the demand filling rate - has been more or less referred by every component in this study even though there is no target fulfilment rate.

The fill rate is not a concern for the transporting agencies while it is a concern for all other stakeholders in the supply chain. Lead time is the difference between the ordering date and the delivery date which influences the supply chain performance positively if shorter and negatively if longer. Customer response time and complaints are with their usual meaning and affect the supply chain depending upon their intensity – the lower the better.

As stated earlier the fill rate of the procurement chain (e.g. MP, DCS and BMC) is the quantity delivered to the next phase from a particular phase. It may be noted here that there is no target given to this stakeholders. Production plant uses all the concepts of the responsiveness while some varying degrees of the same are being used by other stakeholders to know their degree of responsiveness to the market place.

3.9.4 Product quality – the ability to provide superior products

Under the quality manufacturing head appearance, taste, shelf life, safety and reliability of the product are some of the extremely useful terminologies as the very nature of the raw material as well as the products are perishable which may be fatal if consumed in the damaged form. So the dairy food supply chain keeps into account all these parameters at every stage and due care is taken for production, processing and distribution of the same for delivering it fresh and safe. All the terminologies are quite clear in their literal meaning while the reliability of the products says about the deviations between the promised and the actual. Higher the deviations lower the reliability which brings up discontentment irrespective of the situations and stakeholders.

Among all the components the production plant is entangled with these parameters while delivering the safety produce (milk) is an important criterion for the procurement chain members. It is seen that awareness of quality and safe milk production among the producer members are lacking which not only reducing their ROI due to lower price rather decreasing the food value requirement of the milk causing serious problems for the production plant for further processing.

It is expected that the transporting agencies deliver the raw and processed milk (products) to the concerned stakeholders in the right state so that customer complaints of delivery of damaged products could be minimised. Retailers do not have any role to affect the quality of the products since they are meant to sell only delivered products from the production plant.

3.9.5 Process quality – the ability to follow standard operating procedure

Traceability, ”storage and transporting conditions”, working condition, chemical use, energy use, sales promotion, display in the shops/parlours and customer service are some of the important parameters considered for measuring the process quality under which a specific stakeholder operates. If the process quality is superior then the product quality will be superior under some specific conditions like superior raw materials, skilled manpower etc.

Traceability is one of the most important criteria for having superior processing since the pre-requisite information and the whereabouts of the products can be known by this parameter. This is facilitated by the use of various information tools like barcodes, radio frequency identification (RFID) and global positioning systems (GPS). Though in this case the RFID and GPS are not being prevailed still the use of barcodes on the products are quite common to convey the desired information of the manufacturer. To keep track of the logistics this is also quite important and the use of cell phones facilitates the process.

For the procurement part of the supply chain it is extremely important to have good working, storing and transporting conditions else the possibility of perishability can’t be avoided. For the BMC and production plant the use of chemicals as preservatives are important to keep them out of damage but using it above the optimal level could be dangerous and might increase the processing/production costs too.

Store display, sales promotions and customer service are some of the important criteria at the customer sales interface especially at the level of retailers. Sales promotions and the customer service to the retailers and the industrial customers these are also some major parameters at the production plant level. Other stakeholders do not have anything to do with these parameters since they are not directly involved with the end users.

3.10 Supply Chain Operational Issues in Dairy Industry

A typical dairy food supply chain involves seven stakeholders e.g. milk producers, dairy cooperative societies, bulk milk coolers, production plant, transporters, retail outlets and customers. In the forward direction the material/product of the supply chain flows while in the reverse direction the finance flows. In either way the information and knowledge flow occur in order to expedite various operational processes. In this case, milk producers and dairy cooperative societies are the supplier's (bulk milk cooler) suppliers of the system and customers at the end are the customers' (retailers) customers.

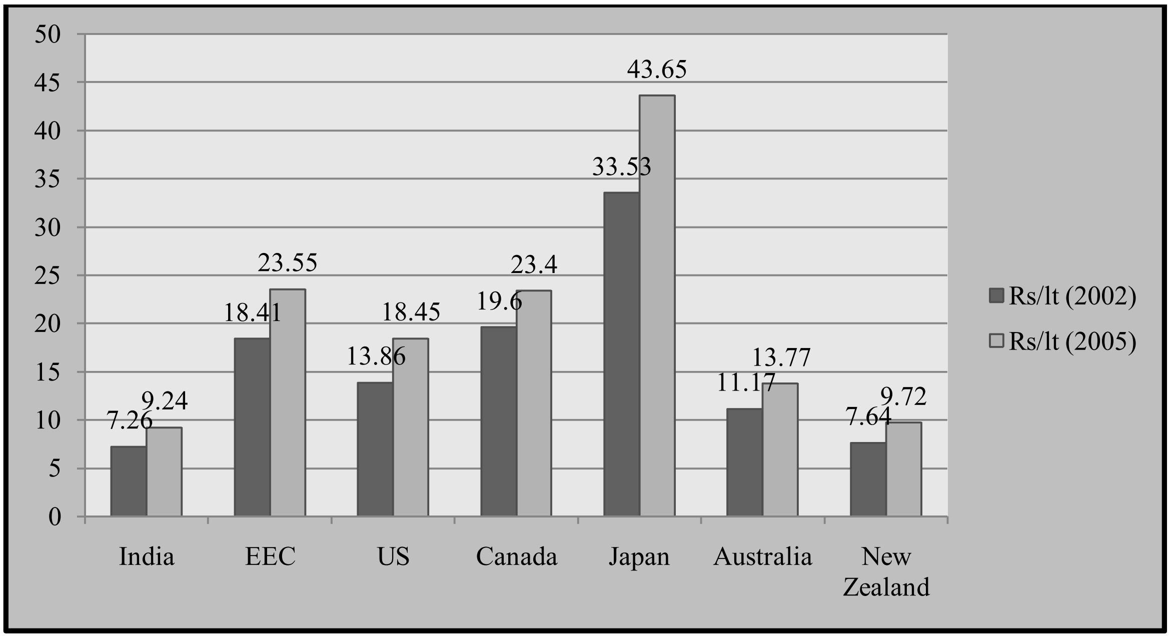
The whole distribution is taken care by the third party logistics (TPL) providers while the in-bound logistics is a part of the union (BMC) function. It is already seen that the transportation part is largely taken care by the TPLs (84 percent as said in Sople (2004) and hence the dairy industry is no deviation in this case. The basic aim of the supply chain is to make the products reach the end point without damage while obeying the basic management principles like right time, right place and right person. In this way while cost is the factor to be minimised, profit and customer satisfaction (overall value) is to be maximised. The following discussion will be on the basic functions of the supply chain with respect to cost and customer satisfaction.

3.10.1 Milk producers vs. milk production

Dairying is basically a women centric activity found in the villages or in the suburban areas. Basically people from the below poverty line chose animal husbandry and dairying as one of their professions. While the male-earners in these families take care of the cultivation and agricultural related activities; females rear cattle or buffaloes in the sheds to produce milk and to have extra income for the family.

The cost of milk production at the farmers' houses is one of the major issues in the supply chain. Higher is the cost of production lower is the overall supply chain profit. If due weightage is not given to this and farmers' are underpaid for their produce then discontentment among them might rise and lead to lower farmer involvement in the cooperative based supply chain.

Japan is expending the highest (Rs.43.65/lt) for the milk production followed by European Economic Community (EEC) and Canada. India is expending the least for milk production (Rs.9.24/lt) which is being proceeded by New Zealand (Rs.9.72/lt). The cost of milk production in India is quite competitive in the world and so is New Zealand, though it produces one fifth of India's milk production.



Source: Compiled from ICAR (2002) and Nataraj (2005)

Figure 3.3: Country-wise cost of milk production

While India is the greatest milk producer, New Zealand is the greatest exporter of the dairy products in the world. The cost of production over a period of years is increasing by at least 10 percent due to the inflation on fodder items which is responsible for almost 60 percent of the cost of milk production. Some of the major countries' cost of milk production per litre is depicted in the table to compare by bringing a contrast to India's cost of production. In all the cases due to the inflation on feed and fodder items, there is an increasing trend in the cost of production experienced by all the countries.

3.10.2 Factors of milk production

Venkatadri, Rani and Reddy (2008) have evaluated the cost of milk production at the farm gate in Chittoor district of Andhra Pradesh. The details of the various heads of expense have been mentioned in the table below. In the recent study the cost of milk production has also been calculated and compared with the study made by the researchers mentioned here. The table is depicted here to analyse the various cost factors of milk production and the same to be used for evaluating the cost of milk production for the ongoing study.

Table 3.6: Calculating cost of milk production

Cost heads		Description	Rs.
Fixed costs	Cost of animals	2 cows @ Rs.12,500 per cow	25,000
	Transportation to home	@ Rs. 350 per cow	700
	Equipments	Total Rs. 600 for 2 cows	600
	Cost of shed	Total Rs.1,000 for 2 cows	1,000
	Total fixed costs	-	27,300
Variable costs	Grazing expenses	Rs.200 per annum per cow	400
	Dry fodder expenses	Rs.3,000 per annum	6,000
	Depreciation	Fixed costs distributed over 6 yrs	4,550
	Labour charges	@ Rs.55 for 8 hrs/day for 365 days	20,075
	Insurance premium	@ 5% per cow's cost	643
	Health & medicine exp.	@ Rs. 250.00 per cow	500
	Concentrates	@ Rs. 8/kg @ 2 kg/day/cow	11,680
	Interest/opportunity costs	@ 8% per annum on fixed assets	2,184
	Total variable costs	-	46,032

Source: Compiled from NIRD report (2008)

Annual milk production from two cows = 2,400 litres

Cost of milk production/litre = 46,032.00/2,400 = Rs.19.18

Cost of milk production/litre (excluding interest and depreciation) = 32,298/2,400

= Rs.16.37

After coming across all the necessary factors like fixed and variable costs, the milk production cost per litre is found to be Rs.19.18 per litre. The cost of production will decrease by 15 percent to make it to Rs.16.37 per litre, if depreciations and interests are not considered. It may be noted here that if number of cows are increased at a constant milk production rate the cost will be more than expected. In the similar way if the average production per cow per day reduces, the cost of milk production will go up. The details will be further discussed in the analysis section of the milk production in the study. So it's better to have less number of cows with high milk production rate. But in most of the cases it is seen that a typical milk producer owns 1-5 cattle in his/her shed (ICAR, 2002).

3.10.3 Dairy cooperative societies vs. collection of milk

Dairy cooperative societies play a vital role in employment generation to the rural people (Jithendra Kumar & Shankara Murthy, 1992). Irrespective of the seasons it provides a perennial source of income unlike any other agricultural professions. The dairy cooperative societies play a vital role in procuring milk from the milk producers and deliver that at the chilling centres for chilling as a treatment of post harvesting process. They collect milk from their members twice a day and send it to the specified BMC through their head loaders. The head loaders not only carry the collection to the BMC rather help the secretary of the DCS in other activities too. In absence of the secretaries, the presidents and the head loaders operate the society and collect milk from the milk producers. There are three basic functions rendered by the cooperative society namely managerial, operational and input services.

In the managerial purview the set up of a new society by the endeavour of the supervisor of the union and managing the same by involving milk producers as members. Each member is asked to pay a nominal fee of Rs.11 towards the membership charges of which Rs.10 is towards purchasing a share of the cooperative and the rest is towards the entrance fee. The cooperative societies are managed by forming a governing body of nine members through an electoral process. The secretary of the society is the in-charge of the overall functions and maintains the records, makes payment to the producers for their sales and distributes the incentives/bonus on behalf of the dairy federation/union. Among the operational activities are the receiving the milk from the producers twice a day, testing it for fat and SNF and dispatch the same to the bulk milk coolers through the head loaders. Apart from this at the society level local milk sale, organisation of the milk producers into these societies is also being taken care.

On behalf of the union/federation the secretary and head loaders of these societies undertake various other activities like sales of feeds, medicines and organising health camps for the cattle and artificial insemination programmes (AI) at their locality. This facilitates sound milk production culture among the producer members and motivates other milk producers from unorganised sector to join societies.

But most of the times it is seen that milk producers do not stick to the system even if they produce milk on continual basis. They resort to some other means for selling their produce in anticipation of higher price. This leads to serious procurement problems in system and decreases ultimately the production level at the plant.

A statistics provided by the DairyCo (2009) says that more than 13 percent of the farmers leave the industry within two years of their joining. Almost two third maintain the same level of productions over a period of years and others increase their production. So the attrition is quite common in the field of milk production and its sale to the societies. This is a case in corporate farming so the case of Indian milk farming could be realised from this. It may be mentioned here that all most all the developing countries follow same kind of supply chain where the produce (milk) directly enters the plant by removing the components (society and chilling centre) unlike Indian cooperative based dairy supply chains.

3.10.4 Bulk milk coolers vs. chilling & transportation

The milk union, being one of the major constituent parts of the Anand pattern dairying, plays a vital role in the procurement of milk from the producers through the cooperative societies and chill it at the BMCs. There are several projects of the state/central governments under which these BMCs are set up in the sub-urban/urban areas. Clean Milk Production Programme, Intensive Dairy Development Programme (IDDP), Rashtriya Krishi Vikash Yojana (RKVY) etc. are some of the major projects which facilitate the process.

BMCs or the chilling centres chill milk collected from the DCSs at around 4^0C temperature and subsequently send it to the production plant for further processing. Once in a day, the milk is collected by the tankers from the respective BMCs as per the route assigned to them. The tankers are maintained at around 25^0C -30^0C temperature in order to transport the content without damage till it reaches the production plant. Before chilling the procured milk is tested for the fat and SNF level and recorded and sent to the plant for payment. Sometimes the mismatch of the fat and SNF level at the BMC and production plant brings up discontentment among the stakeholders and deviations in it lead to problems. If the fat and SNF (total milk solids) is more than that is recorded in the list then there is no complaints and payment is made accordingly otherwise deductions from the payment is made. However, the milk is tested for fat and SNF through either Gerber method (manually) or Milko tester where the latter is an easier process to conduct.

3.10.4A: Gerber method/Milko tester

Solution of 10 ml milk + 5 ml H_2SO_4 (Sulphuric acid) + 2.5 ml C_2H_5OH (Amyl alcohol) put in the butyrometer and rotated in the centrifugal machine (1, 200 rotations per minute) for three minutes (manually) in order to detect the fat level and once the fat is detected the SNF can be calculated using the following formula. Now-a-days it is determined with the help of milko-tester (A Danish invention with the help of NDDB). Calculation of solid-not-fat (SNF) and total milk solids (TMS) is done by using the formulae:

SNF = (CLR/4) + 0.21F + 0.36
TMS = Fat + SNF = (CLR/4) + 1.21F + 0.36
Where CLR = Corrected Lactometer Reading and F = Fat content of milk (percent)

In order to detect the price of milk per kg of milk excepting the end points of the supply chain the following methods are used. It may be noted here that the pricing policy for the milk is a policy decision and varies from state to state in the cooperative based dairying system. NDDB, federation authorities, policy makers and milk union authorities usually formulate the pricing strategies. So keeping view to the situations the price varies and is probably not uniform across the country. However the following rules prevail across the country in pricing and payment system upon delivery.

- Due to higher specific gravity 1.0 litre of milk weighs 1.03 kg (1.0 kg = 0.97 lt) and varies with the temperature from 1.02 to 1.04 (ICAR, 2002)
- At milk producer-society level and retailer-customer level unit of measurement is "litre (lt)" whereas at all other levels it is kilogram (kg)
- Price/kg = Quantity*(Fat percent*Fat price/kg + SNF percent*SNF price/kg)
- Milk producers won't purchase and federation won't sell raw milk

3.10.5 Production plant and processing

The milk is delivered by the bulk milk coolers at the production plant for further processing. The processing plants preserve the milk in the silos (with storing capacity of minimum 25,000 litre) and test it for adulterants. The tests are basically carried out to detect extraneous particles in milk like water, starch, gelatine, sugar, sodium chloride, urea, formalin etc. Once the milk is tested and given clearance for processing, it is rendered through several steps to produce packaged milk and other derivates. The main steps in producing pasteurised packaged milk are:

- ⇨ Clarification: extracting foreign particles from milk
- ⇨ Separation: separating fat and skim milk
- ⇨ Standardisation: increasing/decreasing of fat and SNF as per requirements
- ⇨ Bactofugation: separating micro-organisms from milk through "Bactofuge" machines
- ⇨ Homogenisation: unvarying the fat globule size to "one micron or less" for more taste and uniformity in the content
- ⇨ Thermal processing: pasteurisation (63^0C for 30 minutes and 72^0C for 15-20 seconds)
- ⇨ Chilling: cooling by chilled water/glycol solution to maintain temperature at 4^0C
- ⇨ Packaging: packing milk through poly pack machines

These days, to enhance the longevity of milk Ultra High Temperature (UHT) treatment is also being performed (the heating is done at 135-150^0C for 1-6 seconds and packed in multi-layer packets after chilling). The UHT treated milk can be store for a period of 2-6 months by maintaining room temperature. This helps in perishability both at the producer (plant) and consumer level while maintaining the same food values during production. Several other processes followed for the converting milk into products but production and consumption in liquid form is almost half of the total production/consumption of the dairy products (ICAR, 2002).

3.11 Transporters as Third Party Logistics Providers

While some of the dairy federations have their own transport facility in some cases they do not have and resort to the third parties through bidding process of selection. The process starts with the open applications through sealed tenders and selection is made upon the lowest bids. However once a partly is selected for the process he or she is entitled to serve the federation/plant for a stipulated time with due notice period. The party is also supposed to keep security deposit with the plant/federation as per the rules and regulations. The transporters also help the plant in disbursing some other activities apart from usual distribution. However their basic objective is to serve the retailers on time with fresh and damage-free products.

3.12 Retail Outlets and Sales of Products

Retailers play a vital role in distributing the products like milk and its derivatives to the end users. Since the products are highly perishable in nature, the smart distribution and consumption of the same is essential to get rid of damage and storing costs. In some cases the federations are opening of their parlours to facilitate sales of various dairy products still the selection of the agents (retailers) in various localities matters a lot for greater coverage of markets and increase in market share. In most of the urban areas they have been delivered products twice a day viz. early morning and afternoon while in some other areas once in a day the products are delivered.

There is a further scope for the production plant to select agents in the sub-urban/rural areas to open sales counters. The agents are basically endorsed for one year and renewed in the successive years upon meeting a certain level of performance. Since they are the representatives of the plant and work as an interface between the distribution and customers, it is instructed that they should sell fresh dairy products by asking a requisite price. Customer complaints against them is viewed seriously which might lead to "penalty or cancellation of authorisation."

3.13 Customers and Customer Satisfaction

Customers are the epicentre of the whole process. The survival and improvement of the supply chain greatly depend upon the customer satisfaction on the products or service of the federation above all. In order to see that customers are happy on the system a regular market research is needed to be carried out to upgrade the system. In the context of this customer satisfaction issues have been discussed here.

> "A dissatisfied customer will tell seven to twenty people about his negative experience. A satisfied customer will only tell three to five people about his positive experience."
>
> Kan (1995)

According to the Engel et al. (1995) as cited in Mont and Plepys (2003) the customer decision-making process comprises a need-satisfying behaviour and a wide range of motivating and influencing factors. Consumer decision making process has the following steps:

- **Need recognition:** This is a process where the consumer realises the difference between desired situation and the current situation which in turn serves as a trigger for the entire consumption process. Variables like changed circumstances, time, money, new product purchase and consumption influence the process at varying degrees.

- **Search for information:** The consumer searches for the relevant data or information both internally and externally. The internal resources could be his/her memory and past experiences with the product or service. The external searches could be through the advertising, brands, in-store information, information received from sales people, or social contacts etc. The extent of the information search depends on the degree of importance of the purchasing decision to the customer.
- **Pre-purchase alternative evaluation:** This is an assessment of available choices that can fulfil the need of the consumers. In this case the number of alternatives are evaluated and one (several) is (are) chosen as per the requirement of the consumers. Product or service attributes or particular dimensions of their delivery etc. are some of the criteria used for the evaluation process.
- **Purchase:** This is the acquirement of the chosen product or service. In certain cases at this stage the customers might change because of the various circumstances like new information available to them or the non-availability of the desired alternatives. So at this stage the final decision could be fully planned, partially planned or totally unplanned.
- **Consumption:** The utilisation of the procured product or enjoying a particular service. Once the product is purchased it can be consumed over a period of time or can be consumed at a time.
- **Post-purchase alternative evaluation:** In this case the consumer assesses the degree of satisfaction. Satisfaction is the result of a post-consumption evaluation if a chosen alternative met or exceeded expectations of the customer. According to expectation-disconfirmation model, consumers have three levels of expectations about the product or service performance. They are namely equitable performance (what the customer has to receive in return for money and effort spent), expected performance and ideal performance (Oliver 1980).
- **Divestment:** This is the disposal of the unconsumed product or its remnants. Recently the environmental impact of the disposals and wastes of the products are gaining

momentum among the customers. So re-use, re-marketing and reverse logistics etc. are becoming part of the consumer buying behaviour.

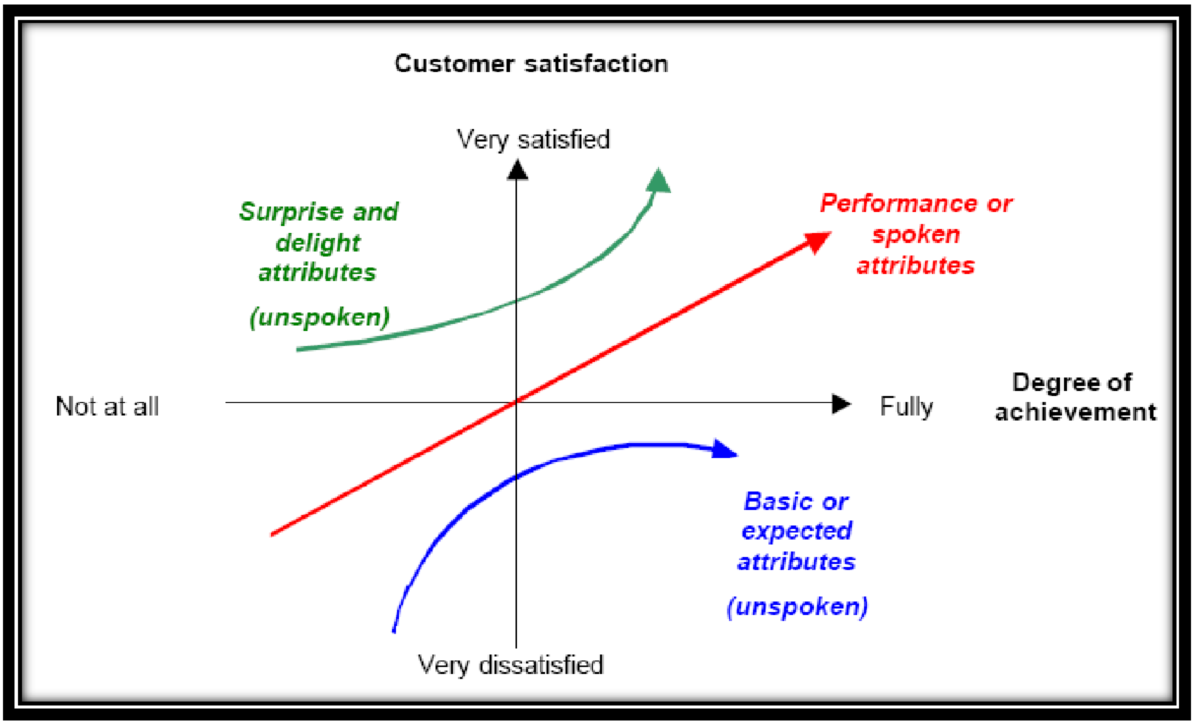


Figure 3.4: Kano's model of customer satisfaction (Source: Kano et al. (1996))

According to the model suggested by Kano et al. (1996) there are three types of product attributes which are needed for bringing customer satisfaction at varying degrees. They are namely:

- Basic or expected attributes
- Performance or spoken attributes
- Surprise and delight attributes

From the above figure it is clear that, higher is the degree of achievement of the requirements higher is the customer satisfaction. In order to have a higher level of customer satisfaction, a company should identify the requirements of the customers and their lookouts in a particular product or service. These lookouts (attributes) of a product can be further imposed into the product at the designing stage through a quality function deployment (QFD) process. The basic objective of this process is to ensure product development process either meets or exceeds customer need and demands. Not only this, QFD process minimises errors and maximises product quality.

Customers are becoming overwhelmingly quality conscious these days due to increase in the disposable income. Though price matters while purchasing still comparing to the quality of the product it is seemed to be an inferior concern. According to Juran (1988) quality is defined as fitness for use – may be a product or service. This could be a relative concept for individuals or organisations as a whole but it is gaining momentum these days to fight with the competition and maximising customer satisfaction.

The unprecedented competition has forced the companies to improve their quality of products and services in order to have survival in the market. A decade ago the scenario was completely different due to less competition. Just after the globalisation the conditions have been drastically changed with too many competitors' existence in the market place. Had it been goods or services, the quality is now-a-days has been a key attribute for satisfying the customers' requirements. The customers do not just buy the products or services rather the bundle of satisfaction within which they want many attributes of varying degrees. These attributes depend upon the products to products and services to services.

In almost all cases the attributes like tangibles, reliability, responsiveness, assurance and empathy play important role in customers' satisfaction level. These are called as the five basic dimensions moulding the customers' expectations and perceptions. If any one of the dimensions lacks he/she gets dissatisfied up to a certain degree. Continuation of the same leads to the distraction towards products or services over a period of time.

Parasuraman, Zeithaml, and Berry (1985) have mentioned about these attributes which are responsible for lessening the gaps in the service quality (SERVQUAL). In this model the expected service describes customers' expectations about what the service firm should provide and perceived service reveals their feelings of the service they actually receive from the firm. If there is a mismatch in the expectations and perceptions then gaps are found which lead to customer dissatisfaction.

The study by LeBoeuf (1987) explains the reasons why a customer quits certain company:

- Only 3.0 percent quit without any reason
- 5.0 percent develop other company relationship
- 9.0 percent leave for competitive reasons

- 14.0 percent dissatisfied with the products/services (tangibles)
- 69.0 percent quit because of indifferent attitude of the company towards customers

In order to measure the customer satisfaction in the dairy marketing there are three major indicators namely product attributes, retailer behaviour and company attitude towards the customers are discussed elaborately in the analysis section.

3.14 Dairy Food Supply Chain Models

In most of the dairy food supply chain across the world, it is seen that either milk collection centres or milk producers themselves deliver milk at the production plant. This is usually practiced in case of developed countries like USA and Europe. But in developing or under-developed countries like India, China, Ethiopia, Nepal etc. the traditional dairy food supply chain comes into picture. Some of the typical dairy food supply chains have been discussed hereunder to bring a contrast among them.

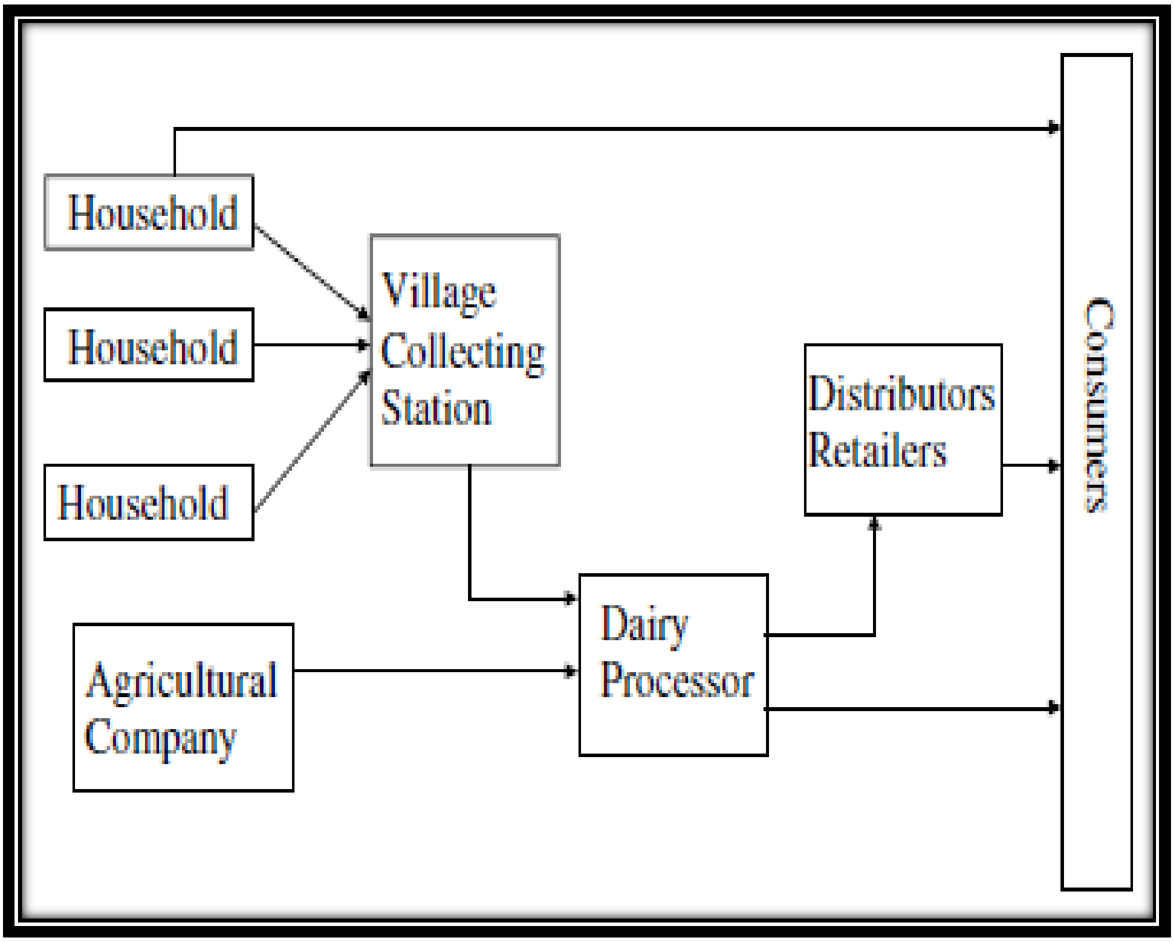


Figure 3.5: Moldova (Russia) dairy food supply chain (Source: Gorton et al. (2006))

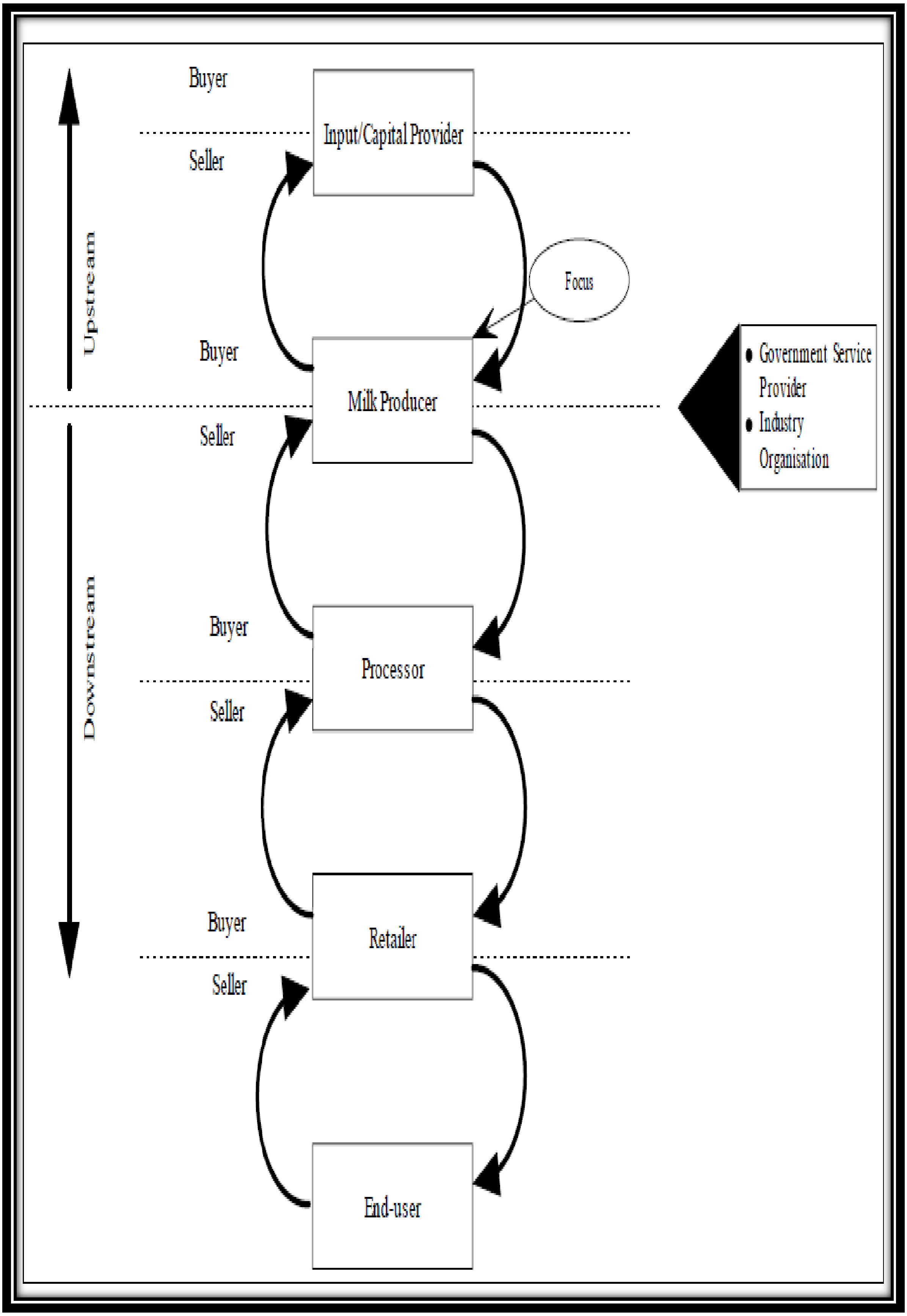


Figure 3.6: Australian dairy food supply chain (Source: Issar (2004))

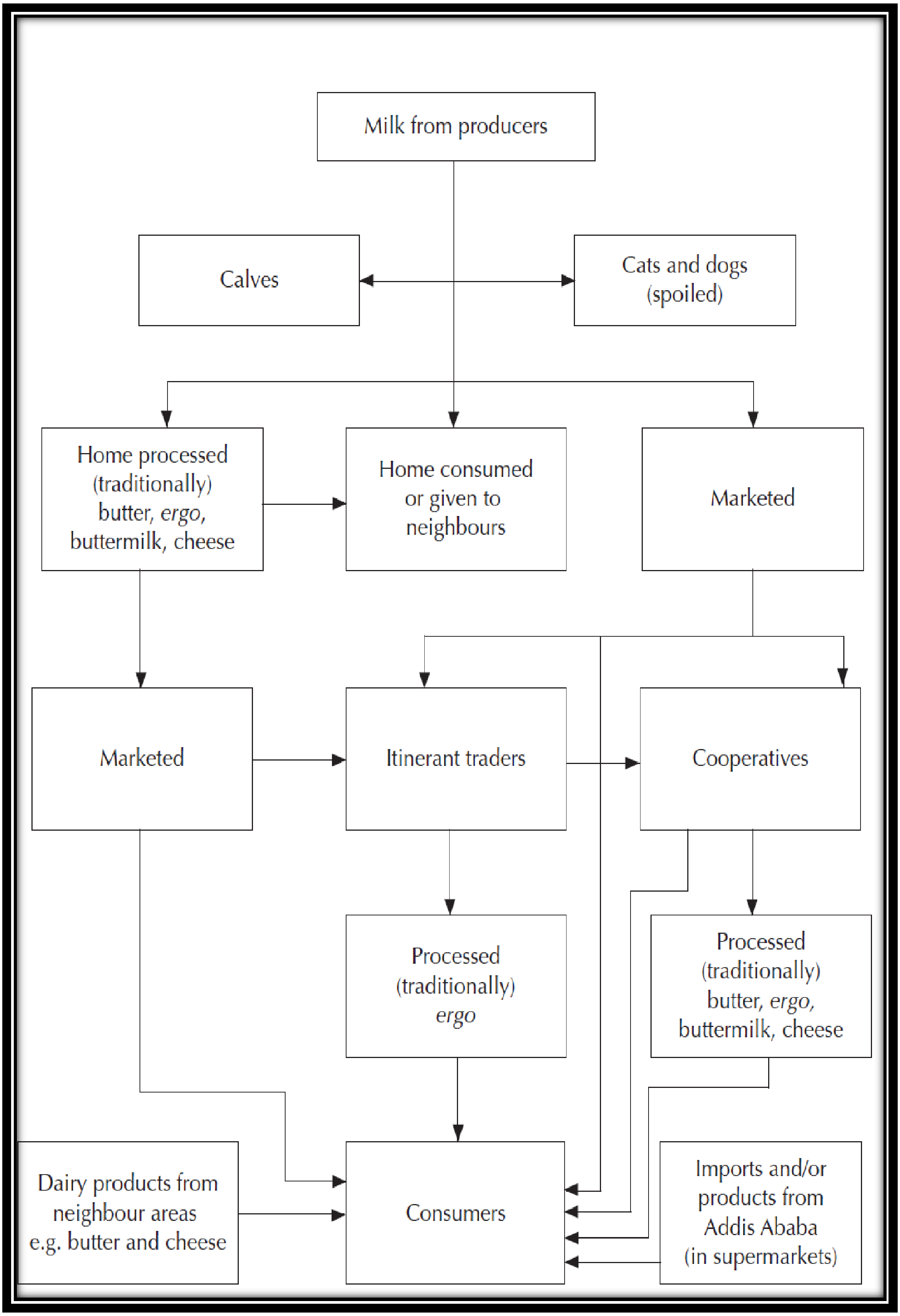


Figure 3.7: Ethiopian dairy food supply chain (Source: Yigrem et al. (2008))

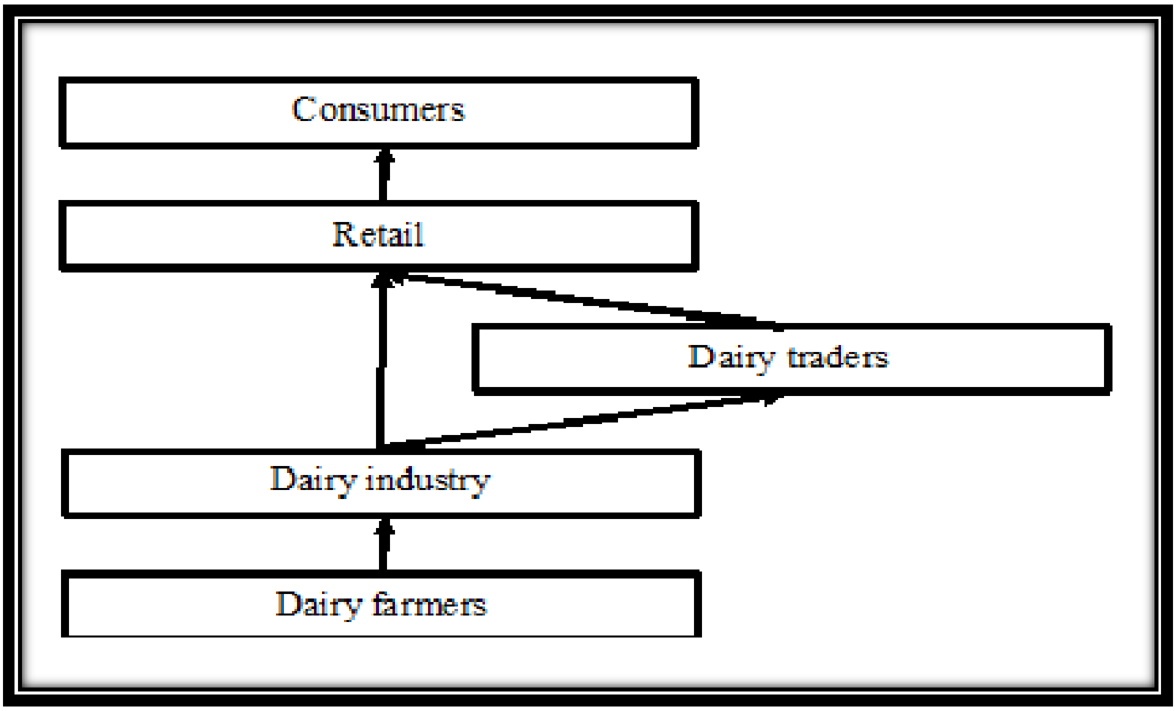


Figure 3.8: European dairy food supply chain (Source: Tacken et al. (2009))

The longer is the supply chain the higher is the cost, lower is the profit and difficult to coordinate. That's the reason why the developed countries follow comparatively shorter supply chain in dairy industry. Moreover keeping in view the dairy farming at the milk producer level, it is seen that at least 50 high yielding cows are reared. In contrast a farmer in India upkeeps only 1-5 cattle (ICAR, 2002) and produces around 700 kgs (ICAR, 2009) of milk per cow per year. Eventually, the method of collection and processing is entirely different and hence so many phases of supply chain come into existence. Still then there is a scope further to look into the system and upgrade in order to enhance the profit level of the supply chain. Contract farming is one such kind which might help the process since procurement is found to be a serious concern for developing/underdeveloped countries' dairy food supply chains.

Hobbs and Young (2001) highlights some of the major issues of the contract farming issues. It has been seen that the procurement is the most difficult part of the system where the contract farming model could work definitely better while improving the various other parts of it. Furthermore it is another suitable model to improve the sector where the inputs to the dairy farmers are provided to produce and deliver desired quality/quantity milk to the contracting dairy plants. This is where the unions of the federations take the pivotal role to make it convenient to provide all necessary inputs to the dairy producers (especially loans and financial help with tie-ups from banks) under the contract farming agreement. On the contrary the dairy producers or the stakeholders under the shed should not expect too much out of the contract and help the processors to make profits out of it so that a win-win situation can be built up.

3.15 Conclusion

The typical dairy food supply chains of underdeveloped or developing countries like India are sometimes not meeting the expectations of its stakeholders. Keeping view to the longer supply chains it is inferred that, the cost is comparatively higher leading them to operate at a sub-optimal level. If one or two components can be removed from the system it will definitely lead to more profits. Moreover without doing the same if contract farming will be adopted in mass scale then the situation can be improved. Contract farming can be practiced together with the aforesaid models so that procurement level will go up and production/processing could be performed at a higher level.

3.16 References

Aramyan, L. H. (2007). *Measuring supply chain performance in the agri-food sector*. Wageningen University, Wageningen, Netherlands.

Arshinder, Kanda, A., & Deshmukh, S. G. (2008). Supply chain coordination: Perspectives, empirical studies and research directions. *International Journal of Production Economics, 115*(2), 316-335.

Barman, K., Konwar, D., & Kumar, R. (2008). Scientific management – A road to profitable dairy farming. *Indian Dairyman, 60*(10), 68-73.

Beamon, B. M. (1999a). Measuring supply chain performance. *International Journal of Operations & Production Management, 19*(3), 275-292.

Carvalho, H., & Cruz-Machado, V. (2008). *Integrating lean, agile, resilience and green paradigms in supply chain management (LARG_SCM)*. Caparica, Portugal: UNIDEMI, Department of Mechanical and Industrial Engineering.

Chopra, S., & Meindl, P. (2003). *Supply chain management: Strategy, planning and operation*. New Delhi: Pearson Education.

Christopher, M., & Towill, D. (2000). Supply chain migration from lean and functional to agile and customised. *Supply Chain Management: An International Journal, 5*(4), 206-213.

Cousins, P., Lamming, R., Lawson, B., & Squire, B. (2008). *Strategic supply management: Principles, theories and practice*. New Delhi: FT Prentice Hall Publications.

Dahlstrom, R., McNeilly, K. M., & Speh, T. W. (1996). Buyer–seller relationships in the procurement of logistical services. *Journal of the Academy of Marketing Science, 24*(2), 110-124.

DairyCo. (2009 March). *Ensuring a sustainable dairy supply chain*. UK: Author.

Ellinger, A. E., Daugherty, P. J., & Keller, S. B. (2000). The relationship between marketing/logistics interdepartmental integration and performance in U.S manufacturing firms: An empirical study. *Journal of Business Logistics, 21*(1), 1-22.

Ellram, L. M., & Cooper, M. C. (1990). Supply chain management, partnerships and the shipper – Third party relationships. *International Journal of Logistics Management, 1*(2), 1-10.

Faisal, M. N., Banwet, D. K., & Shankar, R. (2006b). *Supply chain risk mitigation: Modeling the enablers*. Business Process Management Journal, 12(4), 535 – 552

Frost, C., Allen, D., Porter, J., & Bloodworth, P. (2002). *Operational risk and resilience*. Oxford: Butterworth Heinemann.

Gorton, M., Dumitrashko, M., & White, J. (2006). Overcoming supply chain failure in the agri-food sector: A case study from Moldova. *Food Policy, 31*, 90–103.

Gunasekaran, A., Patel, C., & McGaughey, R. E. (2004). A framework for supply chain performance measurement. *International Journal of Production Economics*, *87*, 333-347.

Hobbs, J. E., & Young, L. M. (2001, June). *Vertical linkages in agri-food supply chains in Canada and the United States*. Canada: Agriculture and Agri-Food, Research and Analysis Directorate, Strategic Policy Branch.

Indian Council for Agricultural Research. (2002). *Handbook of animal husbandry*. New Delhi: Author.

Issar, G. (2004). *Strategies and relationships in the dairy-food supply chain: Options for milk producers in South-east Queensland*. Unpublished doctoral dissertation. School of Natural and Rural Systems Management, University of Queensland, Australia

Jithendra Kumar, D. S., & Shankara Murthy, H. G. (1992). Impact of dairy cooperatives on income and employment in Chittoor district, Andhra Pradesh – An economic analysis. *Indian Cooperative Review, 29*(4), 382-388.

Johnston, D. A., McCutcheon, D. M., Stuart, F. I., & Kerwood, H. (2004). Effects of supplier trust on performance of cooperative supplier relationships. *Journal of Operations Management, 22*(2004), 23-38.

Juran, J. M. (1988). *Quality planning and analysis*. New York: McGraw-Hill

Juttner, U. (2005). Supply chain risk management: Understanding the business requirements from a practitioner perspective. *International Journal of Logistics Management, 16*(1), 120-141.

Kano, N., Seraku, N., Takahashi, F., & Tsuji, S. (1996). Attractive quality and must-be quality. *The Journal of the Japanese Society for Quality Control, 14*(April), 39-48.

Karuranga, E., Frayret, J. M., & D'Amours, S. (2008, May). *Measurement and determinants of supply chain collaboration*. Canada: CIRRELT.

Kauser, S., & Shaw, V. (2004). The influence of behavioral and organisational characteristics on success of international strategic alliances. *International Marketing Review, 21*(1), 17-52.

Khanna, R. S. (2005). Sustainable development of the dairy industry in Asia – Challenges and opportunities. *Indian Dairyman, 57*(2), 21-29.

Knemeyer, A. M., Corsi, T. M., & Murphy, P. R. (2003). Logistics outsourcing relationships: Customer perspectives. *Journal of Business Logistics, 24*(1), 77-109.

Kohl, R. L., & UHL, J.N. (2002). *Marketing of agricultural products*. New Delhi: Prentice Hall of India.

Krause, D. R., & Ellram, L. M. (1997). Critical elements of supplier development. *European Journal of Purchasing & Supply Management, 3*(1), 21-31.

LeBoeuf, M. (1987). *Customer relations: Customer services*. New York: Putnam's Sons

Li, L. (2007). *Supply chain management: Concepts, technology and practices: enhancing value through collaboration*. Singapore: World Scientific Publishing

Mason-Jones, R., Naylor, J., & Towil, D. (2000). Engineering the leagile supply chain. *International Journal of Agile Manufacturing Systems, Spring*.

Mentzer, J. T., Dewitt, W., Keebler, J. S., Min, S., Nix, N. W., Smith, C. D., et al. (2001). Defining supply chain management. *Journal of Business Logistics, 22*(2), 1-25.

Moberg, C. R., & Speh, T. W. (2003). Evaluating the relationship between questionable business practices and the strength of supply chain relationships. *Journal of Business Logistics, 24*(2), 1-19.

Monczka, R., Trent, R., & Handfield, R. (2002). *Purchasing and supply chain management* (2nd ed.). Singapore: Thomson Learning.

Mont, O., & Plepys, A. (2003). *Customer satisfaction: Review of literature and application to the product-service systems*. Sweden: Lund University, International Institute for Industrial Environmental Economics.

Mulacahy, R. (2003). *Risk management*. USA: RMC Publications, Inc.

Murray, J. Y., Kotabe, M., & Wildt, A. R. (1995). Strategic and financial implications of global sourcing strategy: A contingency analysis. *Journal of International Business Studies, 26*(1), 181–202.

Nataraj, B. S. (2005). *Marketing of milk and milk products opportunities for entrepreneurship*. Karnal, Gurgaon: National Dairy Research Institute.

Nicholas, J., M. (2001). *Project management for business and technology: Principles and practice* (second edition). New Delhi, Prentice Hall of India.

Nyaga, G. N., Whipple, J. M., & Lynch, D. F. (2010). Examining supply chain relationships: Do buyer and supplier perspectives on collaborative relationships differ. *Journal of Operations Management, 28*, 101-114.

Ohno, T. (1988). *The Toyota productive system: Beyond large scale production*. Portland, OR: Productivity Press.

Oliver, R. L. (1980). A cognitive model for the antecedents and consequences of satisfaction decisions. *Journal of Marketing Research, 17*, 460-469.

Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1985). A conceptual model of service quality and its implications for future research. *Journal of Marketing, 49*, 41-50.

Prasad, J. (2005). *Principles and practice of dairy farm management*. New Delhi: Kalyani Publishers.

Pyke, D., Robb, D., & Farley, J. (2000). Manufacturing and supply chain in China: A survey of state-, collective-, and privately owned enterprises. *European Management Journal, 18*(6), 577-589.

Rajgopal, D. (1996). Competition in dairy industry: A study of marketing strategy in Andhra Pradesh. *Cooperative Perspective, 30*(4), 22-29.

Rangasamy, N., & Dhaka, J. P. (2007). Marketing procurement cost for cooperative and private dairy plants in Tamil Nadu: A comparison. *Indian Journal of Agricultural Economics Research Review, 62*(4), 679-693.

Rangasamy, N., & Dhaka, J. P. (2008). Marketing efficiency of dairy products for co-operative and private dairy plants in Tamil Nadu: A comparative analysis. *Agricultural Economics Research Review, 21* (July-December), 235-242.

Rinehart, L. M., Eckert, J. A., Handfield, R. B., Page, T. J., & Atkin, T. (2004). An assessment of supplier–customer relationships. *Journal of Business Logistics, 25*(1), 5-62.

Sadgrove, K. (2005). *The complete guide to business risk management* (2nd ed.). Aldershot: Gower Publishing Ltd.

Schoenherr, T., Rao Tummala, V. M., & Harrison, T. P. (2008). Assessing supply chain risks with the analytic hierarchy process: Providing decision support for the off-shoring decision by a US manufacturing company. *Journal of Purchasing & Supply Management, 14*, 100–111.

Shapiro, J. F. (2001). *Modelling the supply chain*. Duxbury: Pacific Grove.

Siegel, P. B. (2005). *Managing agricultural production risk: Innovations in developing countries*. Commodity Risk Management Group, Agricultural and Rural Development Department, World Bank Report No. 32727, Washington D.C.

Simchi-Levi, D., Kaminsky, P., Simchi-Levi, E., & Shankar, R. (2008). *Designing and managing the supply chain*. New Delhi: Tata McGraw Hill.

Sople, V. V. (2004). *Logistics management: The supply chain imperative*. Singapore: Pearson Education.

Tacken, G. M. L., Batowska, A., Gardebroek, C., Nesha Turi, K., Banse, M., Wijnands, J. H. M., & Poppe, K. J. (2009, March). *Competitiveness of the EU dairy industry*. Project code 20964, The Hague: LEI Wageningen UR.

Tang, C. S. (2006). Robust strategies for mitigating supply chain disruptions. *International Journal of Logistics Research and Applications: A Leading Journal of Supply Chain Management, 9*(1), 33.

Thun, J. H., & Hoenig, D. (2009). An empirical analysis of supply chain risk management in the German automotive industry. *International Journal of Production Economics*, 1-8. Retrieved March 5, 2010, from http://www.ijpe.org

Tiersten, S. (1989). The changing face of purchasing. *Electronic Business*, 22-27.

Vanany, I., Zailani, S., & Pujawan, N. (2009). Supply chain risk management: Literature review and future research. *International Journal of Information Systems and Supply Chain Management, 2*(1), 16-33.

Venkatadri, S., Rani, K. S., & Reddy, G. R. (2008). *A study on improvement in rural livelihoods through dairy farming*. Hyderabad: National Institute of Rural Development, Centre for Self Employment and Rural Enterprises.

Womack, L., & Jones, D. (1996). *Lean thinking*. New York, NY: Simon and Schuster

Yigrem, S., Beyene, F., Tegegne, A., & Gebremedhin, B. (2008). *Dairy production, processing and marketing systems of Shashemene - Dilla area, South Ethiopia*. Hawassa University, International Livestock Research Institute.

Zhu, Q., Sarkis, J., & Lai, K. (2008). Confirmation of a measurement model for green supply chain management practices implementation. *International Journal of Production Economics, 111*(2), 261-273.

CHAPTER IV

ONGOING SCM PRACTICES: PROCUREMENT FUNCTIONS

In this chapter the procurement function of the supply chain has been discussed ranging from the milk production in the houses of the producers till it gets chilled in bulk milk coolers and delivered to the production plant. Cost of milk production, milk producers' perceptions towards the dairy cooperative societies, cost of collection at the cooperative societies, chilling at the bulk milk coolers/chilling centres and transportation etc. are discussed elaborately. Profit and return on investment (ROI) with due consideration to the overall expenditure have been calculated at each level to sketch the financial status of individual stakeholders in the system so as to detect the financial soundness of the supply chain on the up-stream.

4.1 Dairying Farming and Milk Production

Experience in the dairy farming has a vital effect on the milk production and quality of milk altogether (Saravanakumar & Jain, 2008). The average years of experience in case of the milk producers is found to be approximately seven years whereas their participation at the DCS is around four years. The reason behind this is the difficulties to sale the marketable surplus of milk throughout the year compel them to get attached to the organised dairy food supply chain. Initially they start the dairy farming with an intention to sale the surplus milk at the nearby market and to make money out of it. But the competition among too many sellers and the difficulty in transporting to the urban areas throughout the year irrespective of the weather conditions put them under trouble to continue this for a long time.

Ultimately, they prefer to bring their produce to the nearby DCS for sale by taking a membership of it which is an easy process. To become a member of the DCS a milk producer is entitled to pay only Rs.11 and hence probably a high rate of attrition is experienced in the system. It is also seen that that the milk producers with the private supply chains are more experienced than the cooperative based supply chains which could be attributed to better price being paid by the former one (Thirunavukkarasu & Sudeepkumar, 2006). The correlations among the vital variables would be discussed at a later stage while discussing the milk production in details.

The maximum exposure of a milk producer to the dairying as a profession and to the DCS is respectively found to be 20 years and 15 years. The standard deviations in the same are respectively found to be approximately four and two years.

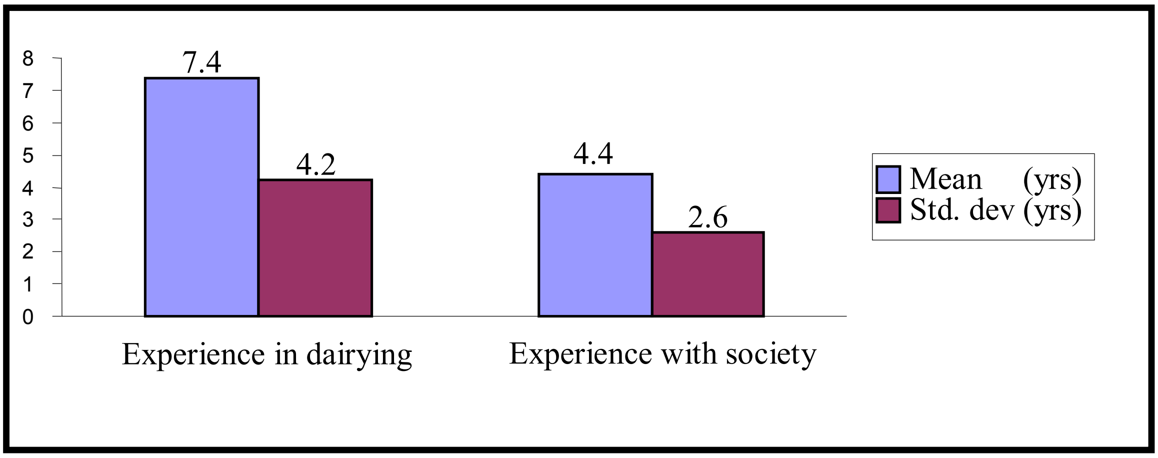


Figure 4.1: Dairy farming vs. society experience

The high standard deviations in case of dairying convey that some of the dairy producers are highly experienced and some are quite new to this whereas in case of DCS more or less they are involved with similar kind of experiences. The coefficient of variation is also similar in dairy experience and experience with the DCS which means the turnover of the milk producers in the profession has same trend as in the case of their participation with the organised dairy food supply chain. There is a high degree of association found between "dairying experiences" and "years at the society" (significant at one percent). In some of the areas the DCSs are set up very recently, so the scope for the farmers for selling their produce to these centres has not been there previously.

4.1.1 Milk production ranges

The milk production characteristic follows the normal tendency, as is expected from a well organised survey method of research.

Table 4.1: Distribution of milk production ranges

Milk production/day	Frequency
Less than 6 litres	49 (14.1)
6 to 12 litres	130 (37.4)
12 to 18 litres	102 (29.3)
18 to 24 litres	41 (11.8)
More than 24 litres	26 (7.5)

It is found from the study area that 14 percent of the milk producers produce less than six litres of milk per day (both morning and evening shifts) with an average of three litres per shift. Respectively 37 percent and 29 percent of them produce “6 to 12 litres” and “12 to 18 litres” per day. It is seen from the table that more than 80 percent of the milk producers produce less than 18 litres of milk per day with an average shift production of 9 litres. It is also seen that the mean milk production per cattle is approximately eight litres with a standard deviation of four litres i.e. to say within the range of “1.5 to 26.3 litres” (three sigma level) all the milk producers are covered. The huge variation in milk production is attributed to their species and the feeding procedure.

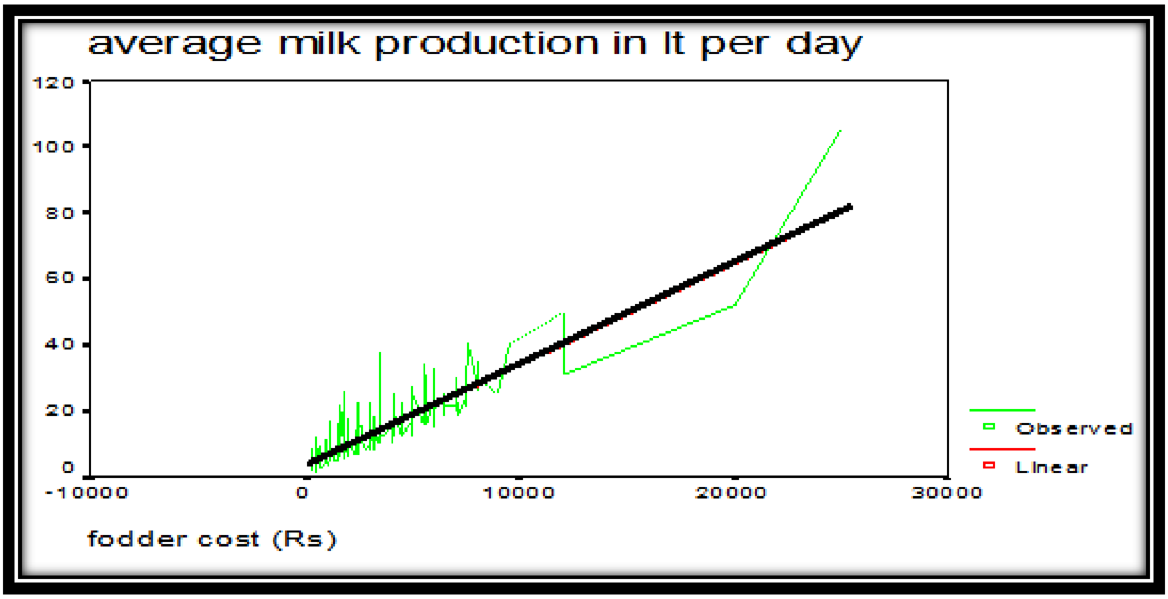


Figure 4.2: Milk production vs. fodder expenditure

It can be seen from the figure 4.2 that, the milk production is varying linearly with the expenditure incurred on the feed and fodder with an upward trend. But in more than two third cases it is found that due to low financial background - milk producers are striving hard to feed their cattle which ultimately reducing their production level. There is a high degree of correlation (0.7) found between the milk production level and fodder expenditure whereas a correlation value of 0.2 noticed with the variable “health and medicines” at five percent level of significance. It can be inferred that higher expenditure on the feeds and health altogether brings up the level of milk production.

The information from the table is pertaining to the milk producers’ statistics of production, consumption and sales to DCS. The milk production systems come across two different seasons namely flush and lean in a year. Moreover the milk production gradually decreases as the cows come closer to their calving.

Table 4.1.1: Milk production, quality level, consumption and sales per day

Statistics	Milk production (lt)			Quality of milk (%)			Consumption (lt)	Sales (lt)
	Flush	Lean	Average	Fat	SNF	TMS		
Mean	16.7	10.4	13.6	4.2	8.2	12.5	1.1	10.8
Std. dev.	11.6	6.6	8.9	0.5	0.3	0.6	0.8	8.9
Minimum	2.0	0.0	1.5	3.4	7.2	11.1	0.0	0.0
Maximum	150.0	60.0	105.0	6.7	9.7	15.3	5.0	102.0

It is seen from the table 4.1.1 that, the milk production ranges from as minimum as 1.5 litres to as high as 105 litres per day. The higher milk production is from the bigger farms with having seven or more cows at their disposal. The average milk production is found to be 13.6 litres per day with a very high standard deviation of 8.9 litres. During the seasonal fluctuations (flush to lean) there is a decrease of 30 to 40 percent milk production experienced at the milk producers' level which not only increase the cost of production rather decrease the production output at the production plant for various milk derivatives.

4.1.2 Quality of milk

The total milk solid (TMS) is the fat and solid-not-fat (SNF) content of milk taken together - higher value is treated to be of better quality. It may be noted here that higher is the TMS percentage higher is the price of milk which ultimately becomes profitable for the milk producers. A fat value of 4.0 percent or less is found in 44 percent of the cases whereas the rest are above this level and going up to as high as 6.7 percent. Similarly the SNF value is found to be varying between 7.2 to 9.7 percent where 90 percent of the milk producers' SNF levels are below the stipulated limit of 8.5 percent. The average TMS of the milk is found to be 12.5 percent which is the prescribed value as fixed by the federation. But the lower and higher limits are depicted in the table to be 11.1 percent and 15.3 percent respectively. The federation these days is deducting milk price proportionately upon not meeting the prescribed quality level of 12.5 percent. Though quality of milk is not much dependent upon the feeding expenditure still a correlation level of 0.2 is found at five percent level of significance. No correlation found between the

TMS level and the "health and medicines". The quality is much dependent upon the cattle species that is the TMS level of jersey cow is higher than the indigenous cows and crossbred cows. In this case the other food values of the indigenous and jersey cows are not considered since it is not a parameter during collection of milk.

4.1.3 Household consumption

It is found that almost 16.0 percent of the milk producers do not keep milk for their household consumption whereas half of them keep 0.5 to 1.0 litres per day. Approximately another one third of them consume 1.0 to 2.5 litre of milk per day. It can be seen from the table that the average consumption of milk per day is around one litre with a standard deviation score of 0.8 litres.

Though there is an increasing awareness level among the consumers for consumption of milk still due to low per capita income and low income of the family as a whole, affordability for the same is found not to be possible in 16 percent of their cases. To confirm the correlation of milk consumption and income of the family are calculated and found that there is a high degree of correlation (0.4) at one percent level of significance. Indirectly it is the landholding which decides the income of the milk producer family and found to be an influencing factor for the milk consumption.

4.1.4 Sale of milk to societies

The surplus milk after consumption is sold to the dairy cooperative societies for earning additional money for the family. The mean and standard deviation of sales are respectively 10.8 litres (as against mean production of 13.6 litres) and 8.9 litres per day which the DCSs collect from the milk producers in contrast. The high standard deviation of sales is attributed to the inability of the milk producers to produce average amount of milk. This is due to low financial and landholding status for which they are not in a position to rear high milching cows.

Statistically it is seen that there is a high degree of correlation (0.6 at one percent level of significance) exists between the financial status and the milk production at the milk producer level. The low financial status does not allow the milk producers to rear qualitative and high milching cows. In contrast, even if some of them are producing higher amount of milk, they do not bring the whole surplus milk to these collection centres. As the milk producers are the members at the cooperative societies, they are supposed to sell their surplus milk entirely to these organisations but deviations are noticed in some cases – indicating an informal sale to outsiders other than the societies. The non-remunerative milk price at the DCSs makes them demotivated to sell their produce entirely. Some of the milk producers even do not bring their surplus milk at all to these societies for which over a period of time DCSs get defunct if practiced on a large scale.

4.1.5 Cost of milk production and its influencing factors

The cost of milk production depends upon various parameters listed in the below given table. While more than half of the cost is incurred for the feed and fodder, another quarter is incurred for the health and medicines. Labour is comparatively cheaper in the rural areas and hence the investment for this factor is found to be low. In 86 percent of the cases it is seen that dairying is a subsidiary profession where people devote their spare time for milk production and hence imposing of outside labour for this activity is found in farms with more than five cows (14 percent). It might be noted here that labour cost is one of the major factors for the milk production and hence has been given due weightage even if milk producers opine it to be their spare time job.

Table 4.2: Factors of milk production

Factors of milk production	Expenses (Rs./litre)
Feed and fodder	8.55 (57.9)
Health and medicine	3.74 (25.3)
Labour	1.45 (9.8)
Depreciation	0.70 (4.7)
Overheads	0.33 (2.2)
Total	14.77 (100.0)

Feed and fodder is the major cost constituting for around 58 percent of the total cost incurred for milk production followed by “health & medicine” and labour cost (table 4.2). If rearing cows is treated to be a part-time activity and is assisted by any of the family members in their leisure time then cost of milk production can be calculated without the labour cost. It is seen that the cost of milk production decreases with the increase in production up to a certain level (50 litres) and increases further. The concept of higher is the milk production lower is the cost is found not to be true always which is clear from the below given figure. Depreciation on the infrastructure and instruments (if any) has been considered for 50 years and 10 years respectively. For the cattle the productive life of seven years has been considered beyond which they are sold to the slaughter houses to earn some amount out of it. Overhead costs are the additional expenses made for purchasing chemicals or sanitary materials for the day to use in the milk production environment. The minimum and maximum costs of milk production are found to be Rs.5.45 and Rs.20.85 respectively depending upon the situation how cattle and buffaloes are reared for the milk production.

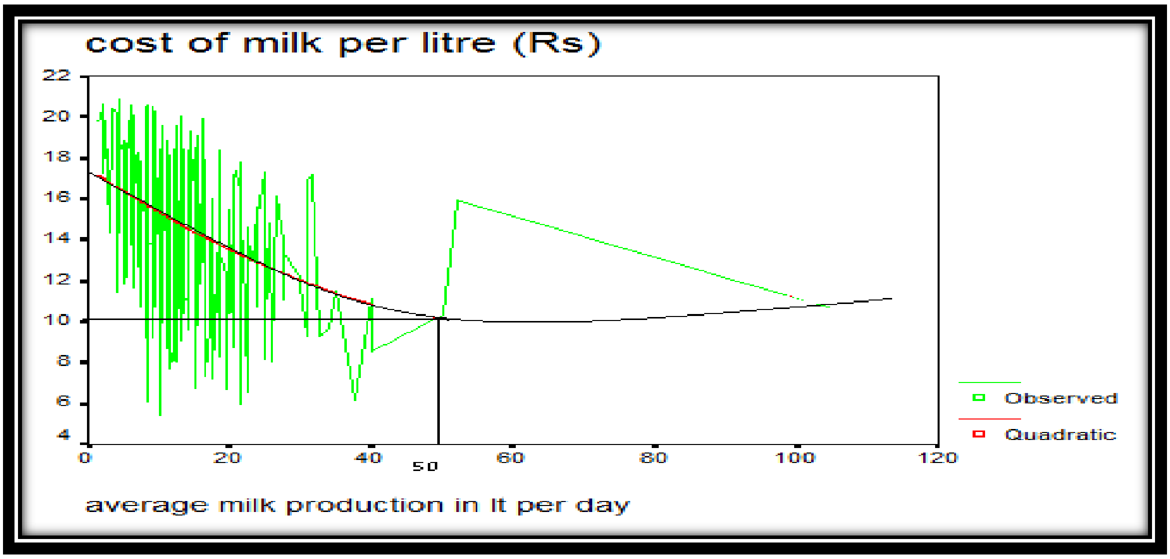


Figure 4.3: Milk production vs. cost

At a constant rate of milk production - increase in the cattle size will substantially increase the cost of production. It is seen that at a level of 50 litre milk production, with the help of two jersey cows, cost of milk per litre is found to be Rs.10 whereas on addition of one more cow brings up the cost up to Rs.15 per litre (figure 4.3). The cost of production will decrease only if the average milk production per cow per day increases. There could be several other combinatorial factors but level of milk production and fodder are the most vital factors as they substantially influence the cost of milk production. One unit of increase in these variables will respectively decrease the cost of milk production by Rs.1.40 per litre (9.4%) and increase the cost by one unit subject to same infrastructural conditions.

Quality of milk (TMS) also has an indirect effect on the cost of milk production as it gives more profit to the producers. Moreover rearing of buffaloes increases the TMS level and hence higher profit can be earned. This is due to the fact that buffaloes do not need extra care and hence investing more on them gives the real benefit. But this is opposite in case of cows as extra expenditure has to be incurred on their feeds, health and medicines which offsets the costs without giving any additional advantage to the milk producers.

Apart from the level of milk production and various costs demographic factors like age, gender, cattle holding, experience in dairy farming etc. do not have any significant impact on the cost of milk production (table follows).

4.1.6 Cost of milk production vs. demographic characteristics

To detect the major influencing factors of cost of milk production, the following correlation table is generated.

Table 4.2.1: Cost of milk production vs. demographic characteristics (Correlations)

Education	1.00							
Main occupation	0.23	1.00						
Subsidiary occupation	-0.03	-0.29	1.00					
Land holding	0.12	0.01	0.20	1.00				
Experience in dairy farming	-0.02	-0.06	0.11	0.08	1.00			
Yrs spent at the society	-0.05	0.01	0.04	0.05	0.62*	1.00		
Cattle size	0.02	0.04	-0.16	0.03	0.08	0.10	1.00	
Cost of milk production	0.04	-0.05	-0.11	0.10*	-0.07	-0.01	-0.05	1.00

*significant at five percent

Apart from the milk production and various costs, the correlation table depicts above the other influencing factors of cost of milk production. But unfortunately, there is no significant contribution found from any other variables. Even the landholding which compensates the cost of feed and fodder has got a low correlation (0.10) with the cost of milk production (significant at five percent). It also refutes of the higher correlation between the landholding and cattle size – in the sense that those with higher lands may not necessarily have opted dairying as a subsidiary profession and upkeep more cattle and vice versa.

4.1.7 Profit and ROI

The following table depicts the sales and profits after meeting the costs. The second and third columns are calculated on the basis of sales and total cost incurred in the process of milk production. Profit without labour is calculated to get an idea whether milk production is profitable even the labour is treated to be out of purview of cost of milk production. Return on investment (ROI) is the profit earned annually upon the total investment made for dairying at the initial stage and has been expressed as a percentage.

Table 4.3: Profit and ROI of milk producers

Statistics	Sales (Rs.)	SP/lt (Rs.)	CP/lt (Rs.)	Profit/lt (Rs.)	*Profit (Rs.)	Profit (Rs.)	ROI (%)
Mean	5,658.29	13.62	14.77	-1.15	1,205.46	-116.38	-7.15
Std. deviation	3,885.34	0.93	3.43	3.44	1,831.41	1,719.18	50.12
Minimum	609.00	10.98	5.45	-8.02	-854.00	-2,938.00	-113.04
Maximum	46,814.00	17.49	20.85	8.42	16,318.00	13,318.00	308.06

*without labour cost (CP = Cost Price, SP = Sales Price)

The mean cost price is already discussed to be Rs.14.77 per litre and hence the profit made by selling one litre of milk is Rs.-1.15, the negative profit is due to the higher cost price than sales price. The high standard deviation of Rs.3.44 depicts the higher fluctuation in the TMS level and hence a higher fluctuation in the sales price. On an average the loss per litre is found to be Re.1 with a high standard deviation (3.44) indicating that some make good profit out of their sale irrespective of the price what they get from the union. This is due to the lower fodder cost compensated with pastures available nearby the milk producers' house and high milk production in certain cases. The maximum profit per litre is found to be Rs.8 which is not very common throughout the dairy farming community.

The mean profit is found to be negative whereas the profit "without the labour cost" is somewhat positive (Rs.1205.46) and not very impressive too. The profit per month shows how sound is dairy farming to be practiced as a profession. The maximum profit is found to be Rs.13,318 per month. The standard deviation in this case is depicted to be Rs.1,719.18 – the higher value could be attributed to the higher fluctuations as said earlier (table 4.3). In almost two third cases the profits are negative so is the return on investment. Another 22 percent of milk producers make a profit of less than Rs.1,500 per month. But if the profession is treated to be a part time affair and labour cost is not taken into consideration then the profit is slightly improved and negative profit is found to be in 22 percent of the cases. The return on investment is negative indicating the lack of profitability of dairy farming as a whole. The cost of milk production in most of the cases is found to be higher than the selling price at the cooperative societies. Furthermore the quantity of milk production is another barometer which decides the profit level and the ROI. It is seen that the profession is profitable if the minimum level of milk production is about 16 litres per day supported by two cattle.

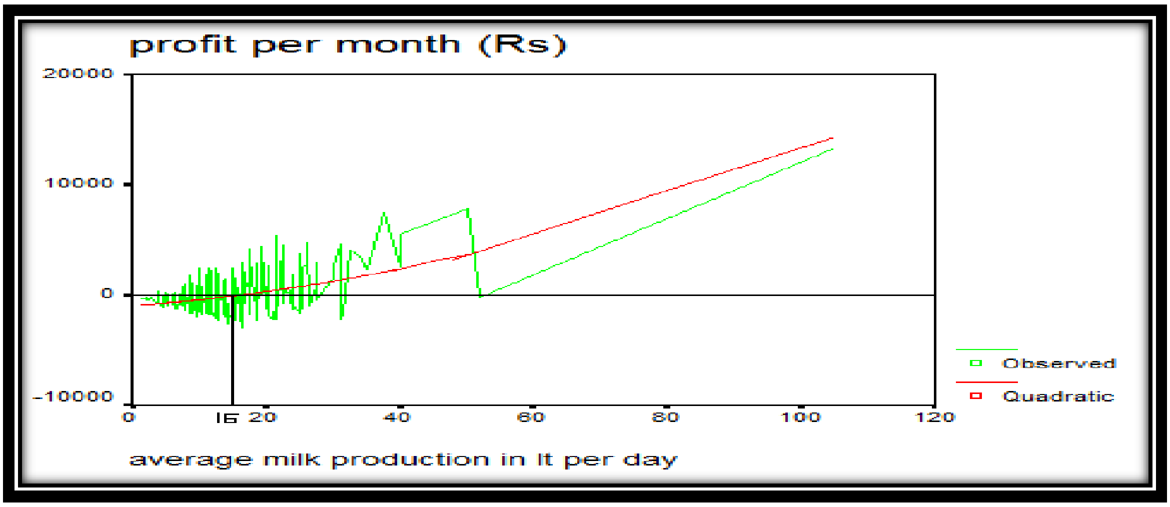


Figure 4.4: Milk production vs. profit

The mentioned figure 4.4 depicts the milk production-profit curve which says if a milk producer produces less than 16 litres of milk per day then negative profit is achieved and exactly at 16 litres there is no profit no loss (breakeven). With the higher values beyond this point the profit increases with the increase in quantity of milk. Moreover there should be a TMS of 12.5 percent else deductions from the milk price might further bring down the profit level.

4.1.8 Cost of milk production vs. ROI

Table 4.3.1: Cost of milk production vs. ROI

ROI (%) / Cost/lt (Rs.)	-113.04 to -7.77	-7.77 to 97.51	97.51 to 202.79	202.79 to 308.06	Total
5.45 to 9.30	-	17 (58.6) (13.8)	9 (31.0) (100.0)	3 (10.3) (100.0)	29 (100.0) (8.3)
9.30 to 13.15	3 (3.9) (1.4)	73 (96.1) (59.3)	-	-	76 (100.0) (21.8)
13.15 to 17.00	101 (75.4) (47.4)	33 (24.6) (26.8)	-	-	134 (100.0) (38.5)
17.00 to 20.85	109 (100.0) (51.2)	-	-	-	109 (100.0) (31.3)
Total	213 (61.2) (100.0)	123 (35.3) (100.0)	9 (2.6) (100.0)	3 (0.9) (100.0)	348 (100.0) (100.0)

The shaded region in the table depicts a profit and hence the ROI is positive. In the first category (8.3 percent) almost all the milk producers are making profit. In this case there is an ample scope for green pastures for the cattle and animal husbandry is treated to be a part time affair. So neither the feeds nor the labour costs are the significant ones for this category unlike others.

Gradually as the cost of production rises the percentage case of negative ROI increases (correlation of -0.86 is significant at five percent). Almost 60 percent of the milk producers' costs of production lie between Rs.9.30 and Rs.17 of which around 50 percent are incurring losses. Apart from the milk production and its cost, other operational indicators have been considered to find the degree of correlations with the ROI.

Table 4.3.2: ROI vs. operational factors (Correlations)

Total milk solid contents	1.00				
Penalty	-0.66**	1.00			
Cost of milk	0.11*	-0.22**	1.00		
Sales price	0.98**	-0.73**	0.12*	1.00	
Return on investment	0.13*	0.04	-0.86**	0.12*	1.00

*significant at five percent level, **significant at one percent level

Penalty on the milk is charged when the minimum TMS level fixed by the authorities is lesser than 12.5 percent. In most of the cases the TMS level is found to be 12 (mode) which is subjected to imposing of penalty there to. This penalty reduces the sales, profit and return on investment by making the milk producers instable in their business and leads to discontentment among them.

Some major correlations found among certain other parameters are mentioned in the above table. It says higher is the TMS lower is the penalty (significant at one percent level), higher is the sales (high positive correlation with one percent significance) and higher is the return on investment (one percent level of significance).

In relation to the return on investment, it is the cost of milk production, which brings down the profit and subsequently reduces the return on investment (significant at one percent level). In contrast, even though the return on investment is significantly correlated with the sales still the degree of correlation is found to be very less (only 12 percent).

4.1.9 Milk producers' perceptions of dairy cooperative societies

Irrespective of such losses and negative ROI, it is intended to test, why people join this kind of organisations. Under this heading nine different parameters have been chosen and tested against each of them about their suitability to the milk producers.

Table 4.4: Society perceptions of milk producers

Variables	Str. disagree	Disagree	Indifferent	Agree	Str. agree
Nearer to house/farm (X_1)	3.1	7.5	21.3	44.8	23.3
Convenient means to sell produce (X_2)	1.1	3.7	14.7	33.9	46.6
Pays regularly (X_3)	2.3	4.9	17.5	25.3	50.0
Provides financial help in need (X_4)	22.7	17.2	23.0	16.4	20.7
Provides inputs at a cheaper rate (X_5)	24.1	19.5	23.3	20.4	12.6
Provides education and training (X_6)	39.9	16.1	21.3	12.4	10.3
Provides technical expertise (X_7)	41.4	22.1	24.1	10.9	1.4
Improves income and savings (X_8)	9.8	12.9	38.5	28.4	10.3
Strengthens societal relationships (X_9)	7.8	6.6	22.4	32.8	30.5

Opinions of the milk producers are taken about their perceptions about the DCSs on various parameters. More than two third of the population agreed upon the factors like, "nearer to house, convenient means to sell produce, regular payment, strengthening of societal relationships" whereas no significant opinions are gather for rest of the factors. In order to detect, the real driving forces of DCSs, irrespective of their non-remunerative price for milk, factors analysis is carried out after it is seen that the preliminary conditions are satisfied.

- Determinant of the Correlation Matrix = 0.34 > 0.00001;
- Kaiser Meyer Olkin Measure = 0.5 < 0.73 < 1.0; and
- Bartlett's Test of Sphericity is verified (significant at five percent).

The following factors are extracted out of the matrix with their factor loadings. In order to have the higher factor loadings the correlation value of 0.5 has been fixed (Hair et al., 1998) which depicts the degree of cohesiveness to the dependent variable. It can be seen that all the factor loadings are more than 0.5 and rearranged according to their suitability to a particular factor.

Table 4.4.1: Rotated component matrix of society perceptions

Rotated factors	I factor	II factor	III factor
Provides inputs at a cheaper rate	0.78		
Provides education and training	0.76		
Provides financial help in need	0.73		
Provides technical expertise	0.57		
Nearer to house		0.68	
Pays regularly		0.67	
Convenient means to sell produce		0.65	
Strengthens societal relationships			0.78
Improves income and savings			0.63

The first factor contributes to 27 percent of the variability whereas the second and third ones respectively contribute to 16 and 13 percent of variability in them to get motivated towards the societies. Almost these three factors contribute more than half of the variations in DCS perceptions. These three factors as per their gravity in factor loadings can be retracted as:

- Input provider
- Hassle free sales
- Empowerment of members

4.1.10 Milk producer level of satisfaction over society participation

In order to measure the level of satisfaction among the milk producers at the society the following analysis is made. The dependent variable is the level of satisfaction being tested over the society operational characteristics as independent variables.

Table 4.5: Model validation: milk producer satisfaction on society

R	R square	Adjusted R square	Std. error of the estimate	Durbin-Watson
0.90	0.82	0.81	0.29	2.02

In order to calculate the level of satisfaction of the milk producers in the supply chain the multiple regression analysis is carried out. From the table above the coefficient of determination "R" is found to be very high and well defines the model. "Adjusted R square (81 percent)" and the Durbin-Watson (almost equal to two) strengthens the model and decides that the independent variables can decide the level of satisfaction of the milk producers (suppliers) over the supply chain. The model is also statistically significant as it is mentioned in the below given table. The significant value is lesser than the defined "p value (0.05)" which validates the whole model.

Table 4.6: ANOVA: milk producer satisfaction on society

Statistics	Sum of squares	df	Mean square	F	Sig.
Regression	125.63	9	13.96	168.70	0.00
Residual	27.97	338	0.08		
Total	153.60	347			

The regression coefficients of the various independent variables deciding the dependent variables have been depicted in the table below. While all the variables are found to be statistically significant, their weightage can be decided from the standardised or un-standardised coefficient values. From the tolerance and VIF (variance inflation factor) multi-collinearity is ruled out from the model.

Table 4.7: Regression coefficients: milk producer satisfaction on society

Independent variables	Unstd. coeff (B)	Std. error	Std. coeff (β)	t statistics	Sig.	Tolerance	VIF
Constant	0.32	0.11	-	2.77	0.01	-	-
X_1	0.11	0.02	0.17	6.97	0.00	0.94	1.06
X_2	0.10	0.02	0.13	5.48	0.00	0.93	1.08
X_3	0.12	0.02	0.19	7.90	0.00	0.92	1.09
X_4	0.13	0.01	0.27	10.04	0.00	0.74	1.35
X_5	0.09	0.01	0.18	6.21	0.00	0.64	1.57
X_6	0.13	0.01	0.28	9.97	0.00	0.69	1.45
X_7	0.08	0.02	0.14	5.16	0.00	0.79	1.27
X_8	0.15	0.02	0.25	9.58	0.00	0.82	1.22
X_9	0.12	0.01	0.21	8.85	0.00	0.92	1.09

Keeping view to the standardised values from the table and their sum a "weightage table" is generated regarding the various independent variables deciding the level of satisfaction. The weightages have been mentioned out of score "1.00" after considering the coefficient sums of "1.82".

Table 4.8: Weightage and mean scores of driving forces of society

Notations	Notation explanations	Std. coeff. (β)	Weightage	Mean	Weightage* mean
X_1	Nearer to house	0.17	0.09	3.77	0.34
X_2	Convenient means to sell produce	0.13	0.07	4.21	0.29
X_3	Pays regularly	0.19	0.11	4.16	0.46
X_4	Provides financial help in need	0.27	0.15	2.95	0.44
X_5	Provides inputs at a cheaper rate	0.18	0.10	2.78	0.28
X_6	Provides education and training	0.28	0.15	2.37	0.36
X_7	Provides technical expertise for	0.14	0.07	2.09	0.15
X_8	Improves income and savings	0.25	0.14	3.17	0.44
X_9	Strengthens societal relationships	0.21	0.12	3.72	0.45
Sum total		1.82	1.00	-	3.20

It can be seen from the table above that the factors relating to the finance and awareness towards the milk production (education and training) etc. have got higher weightages comparing all other variables in the list. The mean scores of each variable have been taken from the opinions of the milk producers to decide the level of satisfaction. Eventually from the last column of the table it can be seen that the level of satisfaction is 3.20 on five point rating scale. This indicates neither the milk producers are happy nor unhappy on the performance of the supply chain being a part of it. This is just a mean to sell their produce and in no other way it is really helping them to improve in their business or living.

4.1.11 Hypotheses at milk producer level

Since the milk producers are the suppliers to the dairy supply chain, it is highly essential to know their overall satisfaction and commitment level to make it more competitive and enduring. In order to detect the same, the value-added activities of the supply chain to their dairy-farming operations have been tested with the help of following hypotheses.

(i) Participating in the supply chain for a long time brings down cost of milk production: It is presumed that higher is the year of participation in the organised supply chain higher is the efficiency to control the cost of milk production since education and training is a part of the day to business of the dairy cooperative societies. The result of the hypothesis is mentioned in the table below.

(ii) Participating in the supply chain for a long time lowers down risks and uncertainties: Before the milk producers join societies they used to have lack of experience in the field of milk production and sales. Once they join they are expected to gain from the process since non-remunerative price for their produce should be offset with some other variables.

(iii) Participating in the supply chain improves overall performance: Reduction of cost of production, education & training, higher profit & ROI etc. are expected to be improved in total.

The results of the hypothesis are depicted in the combined table of Analysis of variance (ANOVA). All the hypotheses are tested by taking the above factors vs. years of participation in the supply chain.

Table 4.9: ANOVA of all hypotheses at milk producer level

Test variables	Sum of squares		df	Mean square	F	Sig.	Inference
Managing costs of milk production	Regression	0.66	1	0.66	0.06	0.81	Rejected
	Residual	4,072.63	346	11.77	-	-	
	Total	4,073.29	347	-	-	-	
Improving risk coping efficiency	Regression	0.00	1	0.00	0.01	0.91	Rejected
	Residual	52.59	346	0.15	-	-	
	Total	52.59	347	-	-	-	
Improving overall performance	Regression	0.00	1	0.00	0.00	0.96	Rejected
	Residual	159.90	346	0.46	-	-	
	Total	159.90	347	-	-	-	

It is found that none of the above hypotheses have come true and hence they are deemed to be rejected. So it is inferred that joining and remaining in the dairy food supply chain for a long time may not necessarily be a value addition for the milk producers. This has been seen from the cost and profit view point of milk production since the supply chain improves profit and return on investment of all stakeholders.

4.2 Milk Collection at the Dairy Cooperative Societies

The milk collected at the dairy cooperative societies from the milk producers and ultimately sent to the bulk milk coolers for chilling. Being at the procurement side of the supply chain, they behave like suppliers' suppliers.

4.2.1 Society operational summary

In this case 531 villages are covered by 168 numbers of DCSs, who in turn entangle 11,545 milk producers as their members. Respectively 42 percent and 43 percent of the DCSs are found to be operating with "less than 50" and "50-100" members whereas only in 16 percent cases membership base is seen to be more than 100. The pitiable matter is that, one in every four milk producers in the rural areas is associated with the society which fosters local milk marketing and lowering down the collections. There are villages found with all milk producers as members of the concerned societies while in some other cases the participation is as low as four percent.

Table 4.10: DCS operational summary

Statistics	Villages covered (nos)	Total producers (nos)	DCS members (nos)	Percentage participation (%)	Male members (nos)	Female members (nos)	Pouring members (nos)	N.pouring members (nos)
Mean	3	271	69	25.0	5	64	43	26
Minimum	1	25	2	4.0	0	0	0	0
Maximum	14	1,500	260	96.0	150	260	150	228
Sum	531	45,485	11,545	-	799	10,746	7,125	4,420

Out of the average memberships (69 nos) at these organisations, the females play a dominant role with more than 90 percent of the memberships. In 88 percent of the cases male memberships is found to be missing and only in 12 percent cases it is detected. The empowerment of women in the scheme is clearly visualised. It may be noted here that even though the female membership is encouraged male membership is not restricted. Moreover if a woman of a family is a member of the society his husband or children also get involved in the milk production and delivery process. The women membership in the state of Orissa is the highest in the country (42 percent) as against the national average of 28 percent (AH&DF, 2009).

Again among the enrolled members two categories are detected viz. pouring and non-pouring. While pouring members supply their produce to the society the non-pouring members won't do the same on regular basis. In their case, the supply is highly sporadic and does not really a value addition to the operation of the DCSs. It has been seen on any given point of time around 60 percent of the members are pouring while the rest are non-pouring. The non-pouring attitude is seen to be greatly influenced by the non-remunerative price at the society and local milk marketing to some extent.

The minimum and maximum years of operation of these societies are found to be respectively, one year and 15 years with a mean of five years (table 4.10). On an average the DCSs are found to be covering three revenue villages with an area of 6.4 sq km. It is depicted in the above table that, the area is of coverage is ranging from 0.5 sq km to as high as 45 sq km (7.5 kms X 6.0 kms). The minimum distance of the DCS from BMC is seen to be 0.0 km (BMC and DCS are at the same location/building) whereas the highest distance of a typical DCS from the milk delivering point is found to be 29 kms.

Table 4.10A: DCS operational summary (continued)

Statistics	Years of operation	Operational area (sq km)	Distance from BMC (km)	Waiting time (min)
Mean	5.0	6.4	7.5	3.2
Minimum	1.0	0.5	0.0	1.0
Maximum	15.0	45.0	29.0	15.0

Keeping view to the memberships the waiting time for delivering milk varies. The milk producers are found to be waiting as high as 15 minutes to deliver their produce at the DCSs whereas; at some of the DCSs within no time (one minute) they are served. The mean waiting time is depicted to be slightly more than three minutes and is seen in more than half the cases. This mostly depends upon the number of milk producers who gather at a time to dispose their produce and "closing & opening" time of the societies. Usually the dairy cooperative societies open at around 7.00 AM in the morning and closes at 9.00 AM. Similarly in the evening it again opens at around 5.00 PM and closes at 7.00 PM. Depending upon the memberships it is the flexibility of the society to open and get closed.

4.2.2 Milk collection at society

The table 4.11 depicts the information regarding the milk collections at the DCSs during flush and lean seasons. It is seen that 30 percent of the DCSs are collecting less than 50 litres of milk per day whereas another 26 percent are able to collect in the range of 50-100 litres. In the same way from 100 to 150 litres category it is found that there are another 25 percent DCSs while the rest are above 150 litres collection category per day.

Table 4.11: Milk collection at society per day

Statistics	Flush (litre)	Lean (litre)	Average (litre)	Fill rate (percent)	Fat (percent)	SNF (percent)
Mean	139.0	88.0	113.0	78.0	4.3	8.2
Minimum	8.0	3.0	5.0	30.0	3.4	7.2
Maximum	560.0	420.0	490.0	175.0	6.5	8.9

The collections of milk during lean seasons are seen to be lesser by 30-40 percent comparing to the flush seasons. The average milk collections in flush and lean seasons respectively are found to be 139 and 88 litres per day with a mean of 113 litres irrespective of the seasons. The minimum and maximum collections are found to be respectively varying widely over five to as high as 490 litres per day indicating a high degree of dispersion in milk collection.

In some of the cases, though not binding, a target is fixed by the supervisors of the unions (BMCs) in milk collection. The fill rates (actual/target) are varying from 30 percent to 175 percent with a mean of 78 percent. The fill rates are found insignificant (p value > 0.05) under "Chi-square test" indicating the alike performance of the DCSs in fulfilling the demand of the union. The average TMS level of these societies is found to be meeting the specifications but varying between 10.6 percent and 15.4 percent which indicate imposing of penalty in some cases.

4.2.3 Milk collection vs. field characteristics

In order to determine the factors behind the high milk procurement in the areas the some of the respondents' profile in this case and field characteristics have been followed.

Table 4.11.1: Milk collection vs. field characteristics

R	R square	Adjusted R square	Std. error of the estimate	Durbin-Watson
0.87	0.75	0.73	48.41	1.88

The factors which are being discussed here are defining the average milk collection per day with a variability of 75 percent (coefficient of determination). Durbin-Watson and

VIF statistics are indicating that there is no multi-collinearity existing in this case and hence independent variables are sufficient enough to define the dependent variable without any biasness.

Table 4.11.2: ANOVA for milk collection vs. field characteristics

Statistics	Sum of squares	df	Mean square	F	Sig.
Regression	1,106,744.44	11.00	100,613.13	42.94	0.00
Residual	365,541.06	156.00	2,343.21		
Total	1,472,285.49	167.00			

From the table 4.11.2 it is seen that, the regression statistics is around 75 percent of the total value, justifying the significance of the test ($p < 0.05$). The coefficients of the various independent factors are mentioned in the below given table from where each factor's influence on the milk collection could be assessed.

Table 4.11.3: Regression coefficients for milk collection vs. field characteristics

Independent variables	Unstd. coeff (B)	Std. error	Std. coeff (β)	t statistics	Sig.	Tolerance	VIF
Constant	-72.47	40.18	-	-1.80	0.07	-	-
Gender of secretary/supervisor	6.08	8.05	0.03	0.76	0.45	0.87	1.16
Age of secretary/supervisor	8.30	8.96	0.04	0.93	0.36	0.92	1.09
Educa. of secretary/supervisor	12.84	6.41	0.08	2.00	0.05*	0.90	1.11
Reason behind formulation	7.51	6.63	0.05	1.13	0.26	0.92	1.08
Registration status	-0.46	8.45	0.00	-0.05	0.96	0.83	1.21
Producers' participation	-0.47	0.21	-0.10	-2.19	0.08	0.70	1.42
Male memberships	0.51	0.24	0.10	2.16	0.03*	0.70	1.42
Female memberships	0.50	0.14	0.26	3.57	0.00*	0.29	3.41
Pouring memberships	1.95	0.19	0.68	10.43	0.00*	0.38	2.63
Yrs of operation with union	-2.71	1.45	-0.09	-1.87	0.06	0.75	1.34
Operational area	0.77	0.59	0.06	1.32	0.19	0.92	1.09

*significant at five percent level

Of the above mentioned variables, educational background of the secretary or supervisor, producers' participation in the organised supply chain, male and female members (taken separately) and the pouring members' contribution to the milk pool are found to be more than any other variables – hence significant at five percent level. Among all demographic characteristics it is the educational background (coefficient of 12.84), which has got the highest positive impact on the milk collections at the DCSs level.

Milk producers' participation in the organised dairy-food supply chain, irrespective of the reasons, is found to have a negative impact on the collection of milk at the societies. The flow of milk producers from the unorganised sector is not really helping the DCSs in improving the collection level. Though it is supposed to hike the collection still the low pouring memberships or high membership with low rate of pouring (60 percent) obstructs the same. Both the male and female members' contribution to the societies are significant where the male representation (regression coefficient of 0.10) is drastically lesser than the female representation (regression coefficient of 0.26).

The common perception, "larger the pouring member base larger is the collection" has also been tested here against the minimum pouring capacity of 1.5 litres per day (milk producers' production data). The rationale behind this is to adjudge the significance of "larger pouring memberships with low capacity" in increasing level of collection. It is found that, pouring memberships matter disregarding the pouring capacity of members. To support the concept, "One way ANOVA" is carried out for average milk collection against the pouring capacity of the milk producers. The p value of 0.46 (>0.05) rejects the concepts by conveying that the milk collection does not get substantially impacted by the pouring capacity of the milk producers. So it is concluded that, higher the pouring members, larger is the collection, irrespective of individual member's pouring capacity (as low as 1.5 litres per day). Excepting these variables, all other variables considered here, do not have substantial contribution to the milk collections at the DCS level, though they are supposed to contribute to the process. The highest "t value" of pouring members among all significant variables further confirms its highest weightage in the collection process.

4.2.4 Cost price and cost of collection

In order to calculate the cost price, cost of collection, selling price etc. the following analyses have been made. The figures have been considered on monthly basis to reach at profit/month and ROI thereto. The mean cost of milk collected at the DCS is found to be Rs.47,122.86 with a high standard deviation of Rs.38,719.79. The minimum and the maximum values in this respect are found to be Rs.2,300 and Rs.198,963 respectively (table 4.12). After a due deduction (not meeting TMS specifications) the cost accrued to the milk producers have been mentioned in the column "net cost". Excluding the cost of collection, the cost price of milk at this stage is varying from Rs.11.23 to Rs.17.12 with a mean of Rs.13.69 that is being paid to a member producer for each litre of milk. The fluctuation in cost of milk is found to be Rs.0.80 per litre which depicts that almost all DCSs' payment is varying from Rs.11.29 to Rs.16.09 per litre (three sigma levels).

Table 4.12: Cost price (CP) and cost of collection (CC)

Statistics	Cost/ mon (Rs.)	Penalty/ mon (Rs.)	Net cost/ mon (Rs.)	CP/lt (Rs.)	H. rent/ mon (Rs.)	Elect/ mon(Rs.)	Misc exp/ mon (Rs.)	CC/lt (Rs.)
Mean	47,122.86	485.89	46,636.96	13.69	125.57	91.16	130.86	0.21
Std. devi.	38,719.79	993.31	38,389.44	0.80	80.70	46.59	99.07	0.30
Minimum	2,300.00	0.00	2,300.00	11.23	0.00	0.00	0.00	0.01
Maximum	198,963.00	6,180.00	196,983.00	17.12	500.00	200.00	500.00	2.37

The DCSs, which function in the rural areas especially, expend very little towards their day to day activities pertaining to house rent, electricity charges, sanitary wares etc. It has been seen that almost seven percent of the DCSs have got their own houses and the rests operate in the rented houses whereas only five percent of them have got artificial insemination (AI) facilities. Including the electricity and other charges a mean expenditure at this level has been found to be Rs.350 per month irrespective of the collections. There is a low degree of correlation (0.26) found between the average collections and the expenses at the DCS level wherein only seven percent variability in the monthly expenses could be attributed to the average milk collections.

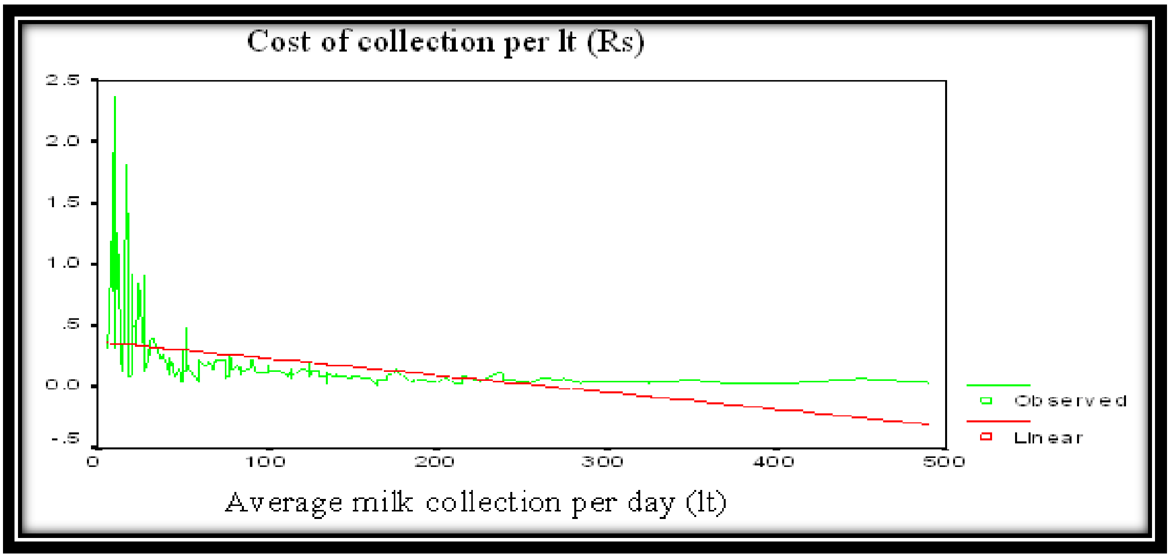


Figure 4.5: Cost of collection

The mean cost of collection at this level is calculated to be Rs.0.21 per litre after meeting all expenses. The minimum and maximum values in this regard are Rs.0.01 and Rs.2.37 with a standard deviation value of Rs.0.30 per litre. Other kinds of cost, that is secretary commission, remuneration for the head loader etc. is usually borne by the union (table 4.12).

In order to see the variability of the cost of collection with respect to the milk collection quantity, the above curve is plotted using the curved estimation. Initially the cost of collection is high where; the collections are less than 50 litres per day. Gradually with the increase in the collection, the cost has come down and becomes apparently parallel to the X-axis (independent variable) showing a negative slope. A close look of the curve ensures that the trend to have ended with the collection of 100 litres per day and after that there is no significant role of it over the cost of collection. Previously it is seen that there is a low degree of correlation (0.26) exist between cost of collection and collection quantity per day even if it is statistically significant at one percent level.

4.2.5 Sales and selling price (SP)

The below given table depicts the sales and receipts figures at the cooperative society level along with the sales price of milk to the chilling centres.

Table 4.13: Milk sales, receipts and selling price at society level

Statistics	Sales/ mon (kg)	Sample/ mon (kg)	Sales/ mon (Rs.)	Penalty/ mon (Rs.)	Net receipts /mon (Rs.)	SP/kg (Rs.)	SP/lt (Rs.)
Mean	3,512.53	13.11	49,533.78	511.43	49,022.35	13.92	14.34
Std. devi.	2,901.30	10.09	40,667.02	1,044.70	40,319.47	0.82	0.84
Minimum	170.10	0.00	2,419.00	0.00	2,419.00	11.40	11.74
Maximum	15,141.00	46.50	208,910.00	6,503.00	206,821.00	17.41	17.93

The sales turnover of a DCS, on an average, is found to be 3,512.13 kgs per month with minimum and maximum sales turnover of 170 and 15,141 kgs respectively. The high standard deviation of 2,901 kgs in sales turnover per month indicates the higher fluctuations in milk collection and sales. It is seen that, 56 percent of the DCSs collect less than 100 litres of milk per day in both the shifts (morning and evening). Cleary their one shift collection falls below 50 litres. Other 30 percent of them are slightly in a better off position, who collects “100 to 200 litres” per day. Within “0 to 200 litres” category, 86 percent of the DCSs are covered whereas; within “0 to 300 litre” almost 96 percent of percent of the societies are covered. Considering the collections, fat and SNF price and sample collection (10 ml of milk collected separately as sample for testing from each milk producer), the sales turnover (Rs.) has been calculated. It says the minimum and maximum sales turnovers are Rs.2,419 and as high as 208,910 respectively indicating that almost 60 percent of the DCSs have a mean sales turnover of Rs. 49,533.78 per month. In some cases, the net receipts have been calculated after a due deduction (not meeting TMS of 12.5 percent).

It has been seen that almost half of the DCSs are not meeting the specifications and liable to pay penalty thereto. Many a time, they complain that, the specified TMS level of 12.5 percent is an ideal case and needs proper feeding to cattle at milk producers’ level. Consequently, the selling prices at the DCS level have been depicted in the table, both for kg and litre. It is seen that, the prices are varying from Rs.11.74 to Rs.17.93 with a mean and standard deviation of Rs.14.34 and Rs.0.84 per litre. It may be noted here that due to higher specific gravity of milk, one litre of it weighs approximately 1.03 kgs. So the price of milk is higher in case of litre comparing to the unit “kg”. There is a high degree of correlation found between the price and the fat content of milk (0.90) but when it comes to TMS it is a whopping figure of 0.98 (significant at one percent level) retrieved. Though the correlation is significant (at one percent) between the selling price and the SNF still the value is found to be drastically lesser than that of fat by making it to 0.53. Hence the higher sales price is highly influenced by the higher level of fat content.

4.2.6 Profit and ROI

Sales and costs are discussed elaborately in the previous section and hence the profit and ROI can be calculated thereto (details in the table below). Return on investment is also treated to be the return on assets and is expressed as a percentage.

Table 4.14: Profit, assets and ROI at society

Statistics	Profit/ lt (Rs.)	Milk prof /mon (Rs.)	F&M prof /mon (Rs.)	Tot.profit/ mon (Rs.)	Op.exp/ Mon (Rs.)	Net prof/ mon (Rs.)	Assets (Rs.)	ROI (%)
Mean	0.64	2,385.39	411.88	2,797.26	346.10	2,451.16	56,261.90	70.63
Std. devi.	0.04	1,931.50	602.54	2,253.64	168.61	2,210.75	53,152.50	71.17
Minimum	0.51	119.00	0.00	119.00	50.00	-372.00	1,000.00	-40.00
Maximum	0.81	9,838.00	3,000.00	12,222.00	950.00	11,422.00	300,000.00	471.00

The table 4.14 portrays the profit and ROI of the DCSs, after meeting all expenses including payment to the producer-members. The minimum and maximum profits per litre of milk are seen to be Rs.0.51 and Rs.0.81 respectively, with an average of Rs.0.64. The normal curve for "profit per litre" is ranging from Rs.0.51 to Rs.0.81 with a low standard deviation of Rs.0.04 is depicted henceforth. The close fit of the frequencies to the normal curve indicates the data is precise and accurate while it represents the population with less error.

The total profit is the profit made from sales of milk as well as sale of "fodder & medicines" which is usually provided to the producer-members at a subsidised rate after collecting it from the federation/union. The profit made from the fodder and medicines is quite nominal and is in the interest of the producing members. The total profit is varying between Rs.119 to as high as Rs.12,222 per month depending upon the level of collections. The profit after all operational expenses per month is again found to be varying between Rs.-372 to Rs.11,422 slightly lesser than the profit before meeting the monthly expenses.

Since it is found that, the higher the level of collection the higher is the profit (correlation = 0.96, significant at one percent level), hence the negative profit, in case of five percent DCSs, is attributed to the lack of collections at their disposal. As is said previously only seven percent of the DCSs operate in their own houses others operate in the rented houses with a mean asset level of Rs.56,261.90 and nearly same standard deviation.

Out of the 168 DCSs, two of them are found operating from their respective secretaries' houses having assets of worth Rs.1000 only. The belongings are found to be sub-optimal and meant to manage the day to business activities. Thus, those who have got the machines like "milko-tester" etc. are found to be operating with the above mean assets. The "milko-tester" is usually provided by the union to the DCSs on credit basis and the required amount is recovered from them over a period of time-on instalment basis. This particular cost is not taken for consideration here, since most of the cases the amount accrued are found to have been paid already.

Considering the total assets the ROIs thereto are calculated as mentioned at the last column of the table 4.14. Previously it is seen that, five percent of the DCSs have a negative profit, thus making them to have a negative return over their investments (assets). The rest (95 percent) of them is found to have positive returns on their investments ranging from a mere two percent to an enormous 471 percent. Since the DCSs are operating with comparatively lower investments, there is a higher scope for them to earn profit and to make their ROI as positive. The mean ROI is found to be a 70.63 percent with approximately same spread over the normal curve since some of the DCSs are operating with a lower profit (loss) and investment.

4.2.7 Comparison of primary vs. secondary cost/sales figures at society

In order to have a proper justification for the cost price, sales price, profit and cost of collection, "One sample t-tests" are carried out against the specified figures obtained from the union/federation.

Table 4.15: One-sample t – tests for comparing cost and sales at society

Test variables against standard values	t statistic	df	Sig. (2-tailed)	Mean difference	99% C.I of the difference	
					Lower	Upper
CP/lt against Rs.13.76	-1.09	167.00	0.28	-0.07	-0.23	0.09
Cost of coll. against Rs.0.00	9.07	167.00	0.00**	0.21	0.15	0.27
SP/lt against Rs.14.41	-1.14	167.00	0.26	-0.07	-0.24	0.10
Profit against Rs.0.65	-2.17	167.00	0.03	-0.01	-0.01	0.00

**significant at one percent level

The figures mentioned in the first column are the standard values pertaining to the TMS of 12.5 percent. It can be seen from the table 4.15 that, except the cost of collection, all other variables are insignificant at one percent level of significance. More precisely, the hypotheses in those three variables are rejected depicting that, the primary and secondary figures match at 99 percent confidence level. This shows the invariance and strong fit of the model with respect to the accurate figures obtained from the union/federation. In case of the cost of collection, there is no secondary information received and hence tested against "zero". It is found later on that, there is a significant difference in cost of collection among the societies.

4.2.8 Hypotheses at dairy cooperative society level

(i) Higher is the membership higher is the amount of milk collection at societies: The variable is one of the insignificant characters (p value > 0.05) to the milk collection with a negative correlation of -0.47. Hence the assumption is not supported (table 4.11.3). A mere participation of the milk producers in the system may not add value to the collection at the society level.

(ii) The larger the pouring membership the higher is the level of collection at the societies: In this case the "p value" is retrieved to be less than 0.05 and the correlation is positive with a higher value which indicates the acceptance of the hypothesis.

(iii) Higher pouring capacity of members increases the level of collection: With a "p value of 0.46 (> 0.05)", the assumption gets rejected i.e. the higher pouring capacity of less no. of producers is not a value addition. So it's better to have more pouring members with lower capacity than less pouring members with higher capacity.

4.3 Milk Union Ranking in the State Of Orissa

There are 12 major milk unions in the state covering the entire state for procuring milk from the rural areas through the dairy cooperative societies and supplying them to the dairy plants in the urban areas especially at major location of the district. Basic operational details of these milk unions are being depicted here to analyse their stand in the procurement and above all their responsibility to integrate milk producers through dairy cooperative societies.

Based on the various indicators of the milk unions' day to day operations in the supply chain they are ranked. The details of their performance on the various indicators are mentioned in the tables 4.16. The various indicators are organisation of DCSs, memberships, milk procurement etc. are taken into consideration along with the growth (CAGR) for all of them over a period of four years. Then finally a rank table is prepared which is mentioned below the operational table 4.17.

It can be seen that Cuttack, Puri and Sambalpur milk unions are doing better than all other unions. The respective unions in the study is at the fourth position (Balasore milk union) depicting a mediocre performance and need to develop further. Other details of indicator performances could be refereed from the tables. The 246,410 milk producers deliver around 299,023 kgs of milk per day at the societies with an average delivery rate of 1.2 kgs per day. In the similar way, each dairy society procures around 80 kgs of milk per day from its members where Cuttack Milk Union (CMU) and Puri Milk Union Ltd. (PUMUL) are ahead of the state average.

Table 4.16: Comparative statistics of milk unions in Orissa

Particulars	Cuttack	Dhenkanal	Keonjhar	Puri	Sambalpur	Balasore	Mayurbhanj	Ganjam	Koraput*	Bolangir*	Boudh*	Sundargarh	Total
Farmers' Organisation (nos)													
DCS organised	1,341	206	188	949	427	439	85	200	354	262	112	62	4,625
DCS registered	904	81	82	330	306	121	13	58	161	161	59	55	2,330
DCS functional	1,312	56	120	626	376	365	19	161	331	178	55	1	3,609
Farmer membership	77,230	13,802	8,992	47,233	28,027	22,046	5,214	9,208	15,964	9,543	2,892	6,250	246,410
Milk Procurement (KgPD)													
Total procurement ('000 kg)	4,465	34	206	1,608	827	660	15	312	562	241	27	0.02	8,957
Av. procurement	144,022	1,111	6,633	51,867	26,672	21,293	470	10,067	18,122	7,704	983	1	299,023
Av. procurement/DCS	110	17	55	83	71	58	25	63	55	44	16	1	80
Milk Marketing (LPD)													
Local milk sale ('000 lt)	282	0	0	312	0	0	0	0	0	0	0	0	594
Av. milk sale	9,098	0	0	10,057	0	0	0	0	0	0	0	0	19,155
Sales to Omfed ('000 lt)	4,180	35	206	1,387	840	660	15	312	562	244	27	0.02	8,469
A.H Activities (nos)													
Cases treated	1,454	0	321	0	328	491	0	60	3,052	502	0	0	6,208
Vaccination done	110	0	0	1,196	11,330	805	0	90	1,410	160	0	0	15,101
A.I & N.S Activities (nos)													
Total A.I centres	454	42	39	238	205	177	0	32	122	104	20	0	1,433
Total A.I done	7,731	264	371	4,471	2,279	632	0	76	466	233	112	0	16,885
Total calves born	2,916	54	166	2,159	961	197	0	31	172	111	30	0	6,797
Feed & Fodder Activities (MT)													
Cattle feed sold	1,371	30	144	510	240	294	18	100	222	41	13	0	2,983
DCS-marketing cattle feed	1,119	52	120	540	329	365	16	144	199	91	41	0	3,016

Source: MIS Report, OMFED (March, 2009)

*Koraput with Malkangiri, Nawarangpur & Rayagada, Bolangir with Kalahandi & Nuapada and Boudh with Kandhamal milk unions respectively.

Table 4.17: Year-wise milk unions' performance on various operational indicators

Milk unions	Dairy cooperative societies organised (nos)				Milk producer memberships (nos)				Milk procurement/month ('000 kgs)				Artificial insemination (AI) done/month (nos)				Feed and fodder sold/month ('000 kgs)			
	2005-06	2006-07	2007-08	2008-09	2005-06	2006-07	2007-08	2008-09	2005-06	2006-07	2007-08	2008-09	2005-06	2006-07	2007-08	2008-09	2005-06	2006-07	2007-08	2008-09
Balasore	336	386	481	439	17,182	18,628	25,474	22,046	568	666	506	572	405	805	531	952	100	264	296	338
Bolangir	200	209	250	262	9,522	9,522	9,391	9,543	233	221	202	214	3	45	67	103	48	47	43	43
Cuttack	810	1,055	1,257	1,339	59,872	71,304	71,485	75,935	3,474	3,428	3,525	4,125	2,687	4,778	5,001	7,235	573	1,091	1,349	1,416
Dhenkanal	205	206	206	206	13,736	13,802	13,802	13,802	98	117	51	40	128	163	163	252	29	42	22	20
Ganjam	129	189	195	200	7,544	8,944	9,184	9,216	261	275	201	262	79	61	98	78	56	86	70	70
Keonjhar	175	151	175	183	6,972	6,401	7,269	8,493	130	138	161	183	106	216	253	266	38	71	128	139
Koraput	174	193	267	354	11,033	11,736	12,276	15,584	206	307	362	452	0	165	148	270	25	87	72	132
Puri	575	644	777	922	36,799	38,813	42,728	46,413	992	1,161	1,395	1,485	1,965	2,754	3,768	4,486	220	508	608	600
Sambalpur	390	404	423	423	25,056	26,790	27,907	27,907	1,188	1,147	1,220	895	1,051	1,983	1,894	1,967	240	225	270	290

Source: Management Information System Reports, OMFED

Table 4.17A: Ranking of milk unions on existing infrastructure

Milk unions	DCS formulation	Members' participation	Milk procurement	Av. milk/ DCS	Av. milk/ member	AI programmes	Fodder sales	Av. fodder/ member	Av. ranking on growth	Overall Ranking*
Cuttack	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.8	1.3
Puri	2.0	2.0	2.0	3.0	2.5	2.0	2.0	4.0	3.4	2.5
Sambalpur	4.0	3.0	3.0	2.0	2.5	3.0	4.0	5.0	7.2	3.7
Balasore	3.0	4.0	4.0	5.5	6.0	4.0	3.0	3.0	4.3	4.1
Koraput	5.0	5.0	5.0	5.5	4.0	5.0	6.0	6.5	2.0	4.9
Keonjhar	9.0	9.0	8.0	7.0	8.0	6.0	5.0	2.0	3.5	6.4
Ganjam	8.0	8.0	6.0	4.0	5.0	9.0	7.0	6.5	6.3	6.6
Bolangir	6.0	7.0	7.0	8.0	7.0	8.0	8.0	8.0	6.2	7.2
Dhenkanal	7.0	6.0	9.0	9.0	9.0	7.0	9.0	9.0	8.5	8.2

Source: Compiled from Management Information System Reports, OMFED (* by Friedman Rank test rankings are significant at five percent level)

4.3.1 Milk chilling at the bulk milk coolers

The bulk milk coolers are usually set up with financial help from the various agencies like government of India, state governments etc. Usually they are seen with processing capacities ranging from 500 litres to 5,000 litres per day.

Table 4.18: Capacity vs. set up expenditure of bulk milk coolers

Capacity of the plant (lt)	Building (Rs.)	Machineries (Rs)	Total assets (Rs.)
500	150,000	350,000	500,000
1,000	150,000	500,000	650,000
2,000	200,000	800,000	1,000,000
3,000	250,000	950,000	1,200,000
5,000	500,000	2,000,000	2,500,000

Two third of the chilling plants are found to have their own infrastructure whereas another one third of them are found depending upon the rented houses for their set up and operation. Basically the land is provided to them by the federation or else they operate from the veterinary hospital campuses of various locations. Only the construction part is taken care by the union which expends the above amount mentioned in the table. On an average one fourth of the total expenditure is incurred for the required building whereas the rest is expended for the machineries. These machineries are provided to the union or federation by various agencies under the development schemes. A typical 1,000 and 2,000 litres milk processing plant requires a total investment of Rs.500,000 and Rs.650,000 respectively. But for the building a minimum level of expenditure is essential irrespective of the plant capacity. Machineries cost is the major part of the investment in a chilling centre and are mostly provided by the government of India to facilitate milk processing.

Table 4.19: Operational summary of bulk milk coolers

Statistics	Distance from prod. plant (km)	Operational area (sq km)	No of DCSs covered	Distance from DCS (km)	Members under BMCs
Mean	71.0	75.0	11	7.0	557
Minimum	25.0	10.0	1	2.5	55
Maximum	125.0	400.0	32	13.0	1,700

The minimum and maximum distances of the BMCs (bulk milk coolers) are found to be respectively 25 and 125 kms with a mean distance of 71 kms. The BMCs are found to be operating with an average 75 square km of area and DCS base of 11. The minimum and maximum numbers of DCSs under a BMC are found to be respectively one and 32, which shows a larger range of functioning DCSs under it (table 4.19).

The DCSs are generally found in the interior of the rural areas whereas the BMCs are seen in the urban or semi-urban areas with proper road connectivity. The average distance of a BMC from the DCSs is found to be around 7 kms with a minimum and maximum distance of 2.5 kms and 13 kms respectively. It is also seen that the average number of milk producing members under a particular BMC to be 557 with a minimum membership base of 55 and a maximum membership base of as high as 1,700.

Table 4.19A: Operational summary of bulk milk coolers (continued)

Statistics	Milk procure./ day (flush/lt)	Milk procure./ day (lean/lt)	Av. milk procure./ day (lt)	Mach running time/day (hr)	Capacity utilisation (%)	Fat content (%)	SNF content (%)
Mean	944.0	639.0	791.0	7.0	50.0	4.4	8.2
Std. devi.	804.0	612.0	704.0	2.0	26.0	0.6	0.3
Minimum	160.00	60.0	130.0	3.0	13.0	3.5	7.8
Maximum	3,500.0	2,900.0	3,200.0	12.0	130.0	7.0	8.8

The collection of milk is more in the flush seasons and lesser in the lean seasons almost by 30-40 percent. The average milk collection in the flush and lean seasons are respectively 944 and 639 litres with standard deviations of 804 and 612 litres per day. The higher standard deviations are indicating the variations among the BMCs in their day to day operations. The average collection is found to be 791 litres per day with a high standard deviation of 704 litres.

About half of the chilling centres are found to be chilling less than 500 litres of milk per day and another 40 percent of them are chilling 500 to 900 litres per day. More than 1,000 litres of processing per day is found to be rare and is attributed to rest of the chilling centres. While some of them are procuring very high there some other BMCs are not at all performing well indicating a very low capacity utilisation of the plant. In total, the unions through these 33 chilling centres are found to be procuring 26,896 kgs of milk.

The average chilling or the machine running time is found to be seven hours per day with a standard deviation of two hours. It can be further seen that, the minimum and maximum machine running time per day are respectively three hours and 12 hours indicating high fluctuations in capacity utilisation of the plant as a whole. It is also clear that the average capacity utilisation is 50 percent of the plant capacity due to lack of milk procurement by these BMCs. Whereas the minimum capacity utilisation is 13 percent, the maximum capacity utilisation is found to be as high as 130 percent, indicating the plants are under/over-utilised in some cases. The higher is the collection of milk the more time it takes to get chilled.

The fat and SNF level of the procured milk vary from respectively 3.5 to 7.0 and 7.8 to 8.8 percent. The mean and the standard deviations of fat level are respectively 4.4 and 0.6 percent whereas in case of SNF it is 8.2 and 0.3 respectively. The TMS is reportedly found to be varying between 11.3 percent and 15.8 percent with an average of 12.5 – the prescribed level for it.

4.3.2 Procurement of milk vs. other variables

In order to find the variables responsible for higher procurement the multivariate regression technique is applied. Years of operation in the field, area coverage, society coverage and milk producers' participation in the societies have been considered as independent variables to define the procurement level at the BMCs.

Table 4.20: Model summary of procurement vs. operational characteristics

R	R square	Adjusted R square	Std. error of the estimate	Durbin-Watson
0.82	0.68	0.63	425.93	2.00

Table 4.21: ANOVA of procurement vs. operational characteristics

Statistics	Sum of squares	df	Mean square	F	Sig.
Regression	10,783,340.34	4.00	2,695,835.08	14.86	0.00
Residual	5,079,582.63	28.00	181,413.67		
Total	15,862,922.97	32.00			

The independent variables in this case are defining 68 percent of the variability in the dependent variable. The Durbin-Watson statistics in this case is 2.0 indicating no auto-correlation among independent variables. The dependent variable is well defined by the independent variables at five percent level. The coefficients of independent variables against the dependent variable are mentioned in the table 4.22.

Table 4.22: Regression coefficients of procurement vs. operational characteristics

Independent variables	Unstd. coeff (B)	Std. error	Std. coeff (β)	t statistics	Sig.	Tolerance	VIF
Constant	-197.83	217.92	-	-0.91	0.37	-	-
Yrs of operation in field	39.84	23.40	0.19	1.70	0.10	0.94	1.07
Operational area	-1.37	0.89	-0.17	-1.54	0.13	0.95	1.06
No. of societies covered	33.30	15.52	0.35	2.15	0.04*	0.43	2.31
Active/pouring members	0.83	0.26	0.51	3.15	0.00*	0.44	2.29

*significant at five percent level

Out of these four major variables, society coverage and active milk producers' participation in those societies will definitely bring up procurement at the society level as well as BMC level. These two variables are statistically significant at five percent level comparing to other variables. It can be seen that, the operational area is negatively impacting the milk procurement at these BMCs. The larger is the area coverage by a particular BMC, the lesser is the supervision and monitoring, and hence the lesser is the procurement. The fact is highly established from the coefficient table, where absolutely no collinearity is sighted. All the tolerance values are much higher than zero indicating, the well defining characteristic of independent variables without any biasness. In order to get confirmed about the factors affecting the milk procurement/marketing of the union/federation, the following analysis is made based on the secondary data collected from the various sources (table in introduction chapter regarding dairy federations).

4.3.3 Factors affecting milk marketing (Secondary data sources from govt. agencies)

The analysis is based on all major dairy federations of the country. The reliability of the data regarding the federations is seen to be around 0.76 and is acceptable to make an inference. In order to detect the major contributing factors of milk marketing the following discussion is made. Here the milk marketing has been treated to be the dependent variable and members of the DCS, procurement by unions, processing capacity of the plants etc. are independent variables. It may be noted here that only liquid milk marketing contributes to more than two third of total sales of the federations. To confirm the factors contributing to the milk marketing, the regression analysis is carried out.

Table 4.23: Model summary: federations' milk marketing

R	R square	Adjusted R square	Std. error of the estimate
0.95	0.90	0.82	56072.69

The coefficient of determination (R) is found to be 0.95 whereas the "R square" is found to be 0.90 i.e. 90 percent of the variability can be brought in milk marketing with respect to these variables. Moreover the "Adjusted R square" value of 0.82 is a very high figure indicates the representation of the sample to the population. To get confirmed, whether the test is significant or not, the following ANOVA table is shown. Since the data used from various secondary sources so Durbin-Watson and multi-collinearity is not depicted. The next table after ANOVA is depicting the regression coefficients of the independent variables.

Table 4.24: ANOVA: federations' milk marketing

Statistics	Sum of squares	df	Mean square	F	Sig.
Regression	240,972,527,559.33	7	34,424,646,794.19	10.95	0.00
Residual	25,153,172,983.11	8	3,144,146,622.89		
Total	266,125,700,542.44	15			

Table 4.25: Regression coefficients: federations' milk marketing

Independent variables	Unstand coeff (B)	Std. error	Stand coeff (β)	t statistic	Sig.
Constant	-35,451.25	127,984.66	-	-0.28	0.79
Members per DCS	415.30	1,104.31	0.22	0.38	0.72
Members per DCS (W*)	1,408.44	2,956.05	0.24	0.48	0.65
Women participation	-965.19	3,361.07	-0.06	-0.29	0.78
Procurement per DCS	-1,203.05	333.27	-1.33	-3.61	0.01**
AI programme per DCS	139.98	74.19	0.26	1.89	0.10**
Delivery per member	52,711.01	47,314.79	0.24	1.11	0.30
Procurement per union	0.94	0.12	1.52	8.13	0.00**

*W - Women

The table 4.25 indicates that the regression value is much higher than the residual value and hence the independent values discussed are sufficient enough to influence the dependent variable. From the last significance column it can be seen that $p<0.05$, so it is inferred that, the model is statistically correct and can be further considered to analyse the independent variables and their influence on the dependent variable separately (coefficient table follows).

It is observed that, the procurement per DCS or union contributes positively to the milk marketing e.g. higher is the procurement higher is the milk marketing. Delivery per member at the society (earlier pouring member capacity) is observed to be insignificant and hence not much contributing to the level of procurement and marketing. These two inferences confirm the results of earlier hypotheses discussed in the dairy cooperative segment before. So, it is inferred that in order to have higher marketing or procurement the attention is to be concentrated on DCS level milk collections. Probably, due to this Amul is performing very high comparing to other federations in the country.

4.3.4 Sales and purchasing

Once the milk is collected at the BMCs, it is chilled and sent to the production plant for further processing. In some cases, the production plant deducts their amount accrued on gross sales, if the milk does not meet the specifications. Moreover the mismatch of the TMS level at the chilling centres vis-à-vis production plant also a matter of conflict among the stakeholders. The details of operations at all the BMCs have been mentioned in the table follows. It has got purchasing, sales, various expenses, profit and ROI above all.

The procurement of milk is varying from 4,017 kgs to as high as 98,880 kgs per month with a mean of 24,451 kgs. There is a high degree of variation found among the plants in their operations due to the high standard deviation of 21,755 kgs - almost equal to the mean.

The minimum and maximum sales turnover are found to be Rs.61,050 and 1,645,650 respectively per month with due penalties (table 4.26). In almost 70 percent of the BMCs there is found to be no penalty whereas the rest pay penalty due to their low TMS level. The mean and standard deviations in this case are respectively Rs.396,871 and Rs.357,644. The average sales turnover of the unions is reported to be approximately

Rs.19,049,808 per month. The BMCs on an average are paying Rs.50,688 as penalty per month where the average BMC level penalty is found to be Rs.1056 per month.

Table 4.26: Procurement and sales of bulk milk coolers (milk union)

Statistics	Procurement/ month (kgs)	Sales/ month (Rs.)	Penalty/ month (Rs.)	Net sales/ month (Rs.)
Mean	24,451	397,927	1,056	396,871
Std. deviation	21,755	357,403	2,274	357,644
Minimum	4,017	62,310	0.00	61,050
Maximum	98,880	1,645,650	10,380	1,645,650

4.3.5 Cost of purchasing

The BMCs' penalty is imposed by the production plant whereas in return the DCSs' penalty is imposed by the union. In both the cases the actual payment is made subject to meeting the minimum quality specifications. Though it is found in certain cases (penalty imposing) still in most of the BMCs' collection are out of purview of any deduction. The higher is the deductions, the lesser is the sales turnover and hence lesser is the profit. So penalty is adversely affecting the business of the BMCs or union as a whole. The union in return, also deducts the amount in the same fashion from the payment of the DCSs (table 4.27). Since the expenses are incurred on monthly basis hence in order to calculate profit, respective figures are considered for monthly basis except the ROI.

It may be noted here that the deductions are not always a factors where the TMS level is more than 12.5 percent. In around 80 percent of the cases there is no penalty imposed on the DCSs and hence the purchasing cost before penalty is same as the purchasing cost after penalty. The penalty is applicable to both upstream and downstream members in the system. The total purchasing is calculated to be Rs.16,909,632 for the entire month which is being expended by the unions for meeting purchasing costs.

There is an average deduction of Rs.44,928 per month from the payment of the DCSs due to lesser TMS. On the other hand Rs.936 (average) is deducted per society per month for not meeting the quality specifications. The figures are tentative and are not be applicable to the societies who are above the breakeven TMS point.

Table 4.27: BMC-wise financial transactions

BMCs covered	Milk sales (Rs.)	Penalty charges (Rs.)	Net sales (Rs.)	Milk cost (Rs.)	Penalty charges (Rs.)	Net cost (Rs.)	Commiss. of secy. (Rs.)	Remun. of staff (Rs.)	House rent (Rs.)	Electr. exp. (Rs.)	Transp. exp. (Rs.)	Maint exp. (Rs.)	Misc exp. (Rs.)	Depre-ciations (Rs.)	Profit/ month (Rs.)	Profit/ annum (Rs.)	ROI (%)
BMC1	268,290	0	268,290	238,140	0	238,140	4,763	9,000	0	2,000	7,000	1,500	800	333	4,754	57,048	6.34
BMC2	290,280	2,910	287,370	257,670	2,580	255,090	5,102	6,900	700	4,200	6,000	1,000	400	0	7,978	95,736	13.68
BMC3	193,020	1,920	191,100	171,330	1,710	169620	3,392	7,230	1,000	4,000	4,000	2,000	500	0	-642	-7,704	-1.10
BMC4	519,270	10,380	508,890	460,920	9,210	451,710	9,034	17,840	1,300	7,400	22,000	1,250	1,700	0	-3,344	-40,128	-5.35
BMC5	453,420	0	453,420	402,480	0	402,480	8,050	9,330	0	11,000	13,000	500	1,000	333	7,727	92,724	7.73
BMC6	1,055,130	0	1,055,130	936,600	0	936,600	18,732	28,830	0	5,000	18,500	4,000	5,000	833	37,635	451,620	18.06
BMC7	727,080	0	727,080	645,390	0	645,390	12,908	33,320	0	6,200	26,000	2,000	500	250	512	6,144	1.23
BMC8	398,280	0	398,280	353,550	0	353,550	7,071	8,520	1,500	4,200	6,850	600	500	0	15,489	185,868	23.23
BMC9	490,020	0	490,020	434,940	0	434,940	8,699	8,340	0	3,000	11,500	1,500	1,500	417	20,124	241,488	25.42
BMC10	172,890	0	172,890	153,480	0	153,480	3,070	2,640	500	3,600	6,800	1,000	600	0	1,200	14,400	2.88
BMC11	328,530	0	328,530	291,630	0	291,630	5,833	6,180	0	4,500	9,500	1,000	1,000	292	8,595	103,140	17.19
BMC12	319,980	0	319,980	284,040	0	284,040	5,681	15,540	0	5,000	10,800	2,000	500	333	-3,914	-46,968	-5.87
BMC13	715,560	0	715,560	635,160	0	635,160	12,703	17,660	0	10,000	25,000	1,500	2,200	333	11,004	132,048	14.67
BMC14	84,900	4,260	80,640	75,360	3,780	71,580	1,432	2,430	0	2,300	1,800	500	400	292	-94	-1,128	-0.19
BMC15	64,770	1,290	63,480	57,480	1,140	56,340	1,127	3,270	0	1,600	1,500	500	300	167	-1,324	-15888	-2.65
BMC16	1,282,650	0	1,282,650	1,138,530	0	1,138,530	22,771	49,800	0	15,500	43,500	1,500	2,500	500	8,049	96,588	8.05
BMC17	133,800	0	133,800	118,770	0	118770	2,375	2,490	0	5,000	4,500	500	200	167	-202	-2,424	-0.40
BMC18	118,170	2,370	115,800	104,880	2,100	102,780	2,056	3,450	0	2,250	3,700	1,000	500	167	-103	-1,236	-0.21
BMC19	196,320	0	196,320	174,270	0	174,270	3,485	2,910	1,200	4,000	12,000	500	400	0	-2,445	-29,340	-4.19
BMC20	578,670	5,790	572,880	513,660	5,130	508,530	10,171	23,600	0	8,000	14,500	1,500	1,500	333	4,746	56,952	6.33
BMC21	1,645,650	0	1,645,650	1460760	0	1,460,760	29,215	50080	0	14,000	80,000	2,000	2,500	417	6,678	80,136	6.68
BMC22	221,100	0	221,100	196260	0	196,260	3,925	2,790	1,000	5,000	9,000	1,000	400	0	1,725	20,700	2.30
BMC23	407,340	0	407,340	361,560	0	361,560	7,231	19,050	0	8500	12,000	1,500	1,000	333	-3,834	-46,008	-5.11
BMC24	403,050	0	403,050	357,750	0	357,750	7,155	15,900	1,000	5000	13,000	800	1,000	0	1,445	17,340	3.47
BMC25	196,320	0	196,320	174,270	0	174,270	3,485	5,070	0	4,000	5,300	500	500	292	2,903	34,836	5.81
BMC26	390,330	0	390,330	346,470	0	346,470	6,929	11,280	0	5,300	4,600	1,000	500	333	13,918	167,016	25.69
BMC27	134,490	0	134,490	119,400	0	119,400	2,388	2,730	0	3,200	4,500	1,000	500	333	439	5,268	0.75
BMC28	211,260	0	211,260	187,530	0	187,530	3,751	4,590	1,200	5,700	6,000	500	500	0	1,489	17,868	2.55
BMC29	594,660	0	594,660	527,850	0	527,850	10,557	21,440	0	16,000	25,000	1,000	500	500	-8,187	-98,244	-5.17
BMC30	113,520	0	113,520	100,770	0	100,770	2,015	3,240	1,100	3,000	5,200	800	500	0	-3,105	-37,260	-7.45
BMC31	62,310	1,260	61,050	55,320	1,110	54,210	1,084	3,570	0	800	2,700	1,000	300	250	-2,864	-34,368	-5.73
BMC32	93,480	4,680	88,800	82,980	4,140	78,840	1,577	2,640	800	2,500	3,000	650	500	0	-1,707	-20,484	-4.10
BMC33	267,060	0	267,060	237,060	0	237,060	4,741	6,150	0	7,000	6,500	1,000	800	333	3,476	41,712	6.95

Source: Field survey [Profit = Sales – (Purchasing + Expenses)]

Table 4.27.1: Milk purchasing cost at bulk milk cooler

Statistics	Purchasing cost/month (Rs.)	Penalty/month (Rs.)	Net purchasing/month (Rs.)
Mean	353,220	936	352,284
Std. deviation	317,247	2,017	317,460
Minimum	55,320	0	54,210
Maximum	1,460,760	9,210	1,460,760

According to the level of purchasing as mentioned previously the minimum and maximum costs are depicted to be Rs.54,210 and Rs.1,460,760 respectively per month after due penalty. The mean and the standard deviations in purchasing cost are found to be Rs.352,284 and Rs.317,460.

4.3.6 Heads of expense

While calculating the below given expenses all the BMCs are treated as if one entity since they all represent the unions. Wherever essential the separate figures are mentioned for the individual BMCs to get clarity upon the issues mentioned here.

4.3.6A: Commission of the secretaries

The commissions of the secretaries depend upon the collection of milk at the DCSs. They get on an average two percent of the gross sales of milk (Rs.) after the usual deductions. The higher is the concentration of solids and the collection; the higher is the commission of the secretaries. It may be noted here that, the secretary is the overall official in-charge of the DCS who takes care of day to day business. As of today there is no fixed salary for them and the commission system prevails throughout the state.

The secretaries' commission per month varies from Rs.1084 to Rs.29,215 depending upon the level of procurement. The secretaries' commission per society per month is found to be varying from as low as Rs.57 to Rs.2175 depending upon the respective societies' collection and delivery to the BMCs. In total the expenditure in this head is found to be Rs.338,208 (approximately) per month for 48 operational BMCs. It may be noted here that due to sub-optimal level of milk collection at some of the BMCs, the unions stop milk processing at those centres which in return makes them defunct over a period of time.

4.3.6B: Remuneration for head loaders and plant operators

Every DCS has got a head loader who carries collected milk in the 40 litre cans to the specified BMC by means of trolley or cycle. The head loader gets six paisa/km/lt as his remuneration from the BMCs or unions for this activity. In the other hand the operator of the BMC gets a fixed salary of Rs.750 to Rs. 4,000 per month based on the collection of milk ranging from 500 litres (or less) to 3,000 litres (or more). The role of the operator is to chill the milk at specified temperature (around 4 degrees centigrade) and to detect the level of adulteration in the milk (if any) collected from each society separately. The head loader works as means of transportation to the BMCs whereas the operators are based at the chilling plants. Depending upon the processing capacity and level of procurement the staff members at those BMCs varies. Sometimes the plant-in-charge works like an operator whereas in some other big BMCs he/she is assisted by two operators. Average monthly expenses of Rs.12,358 is incurred towards the salary and wages with a minimum and maximum of Rs.2,430 and Rs.50,080 respectively. In total the expenses in this head is calculated to be Rs.593,184 per month.

4.3.6C: Other expenses

Among other expenses house rent, electricity charges, transportation charges and maintenance charges etc. have been considered in order to calculate the profit and ROI. Since the machineries and equipments have been provided to the milk unions by various central and state government agencies, the depreciation is not calculated thereto rather it is calculated for the building on the basis of 50 years longevity. The rate of depreciation on the building is taken to be 10 percent. The minimum expenditure in this connection are found respectively to be Rs.4,067 and Rs.98,917 with a mean of Rs.21,301. The total expenditure in this case is noted to be Rs.1,022,448 per month for all existing BMCs on behalf of the unions.

4.3.7 Cost of chilling

Table 4.28: Cost of chilling and profit per litre

Statistics	C.P/lt (Rs.)	Cost of chilling/lt (Rs.)	S.P/lt (Rs.)	Net profit/lt (Rs.)
Mean	14.63	1.76	16.48	0.09
Std. deviation	0.95	0.28	1.07	0.33
Minimum	12.51	1.23	14.09	-0.73
Maximum	18.13	2.49	20.42	0.79

The average price of milk paid to the DCSs is found to be Rs.14.63 with a standard deviation of Rs.0.95 whereas the minimum and maximum prices are Rs.12.51 and Rs.18.13 respectively per litre. The price of milk with 12.5 percent TMS (4.0 percent fat and 8.5 percent SNF) is Rs.13.76 as is fixed by the federation. The costs of chilling at these BMCs are calculated to be ranging between Rs1.23 and Rs.2.49. The average cost of collection is found to be Rs.1.76 whereas the standard deviation is Rs.0.28 (table 4.28). The cost of collection basically depends upon certain other factors which are going to be discussed little later.

The sales price of milk is ranging between Rs.14.09 and Rs.20.42 with a mean sales price of Rs.16.48 and a profit of only Rs.0.09 thereto. The standard deviations in these cases are Rs.1.07 and Rs.0.33 respectively indicating the variation in sales price and profit across BMCs. The profit in case of the BMCs is ranging from Rs.-0.73 to Rs.0.79, portraying that, while some of them are making profits some are incurring losses (almost 40 percent).

These loss making units over a period of time becoming sick and the unions decide to close them by stopping procurement from corresponding areas. The procurement variations could be attributed to the high proportion of local milk marketing in those areas leading to defunct of the BMCs and making losses to the unions. On an average the profit before expenses is found to be Rs.1.85 per litre across the BMCs (the union) - verified from the secondary information collected from the federation.

4.3.8 Cost of chilling vs. procurement

Table 4.28.1: Cost of chilling vs. procurement

Equation	Model summary					Parameter estimates		
	R square	F	df1	df2	Sig.	Constant	b1	b2
Quadratic	0.15	2.71	2	30	0.08	1.99	0.00	0.00

In order to know how the cost of chilling varies over the procurement of milk a "curve estimation" model has been referred to. From the table 4.28., it is depicted that though the milk procurement is not substantially affecting the cost of collection still 15 percent of the variation in it could be attributed to the average milk collection by the BMCs. So the hypothesis "higher is the collection lower is the cost of chilling is deemed to be rejected."

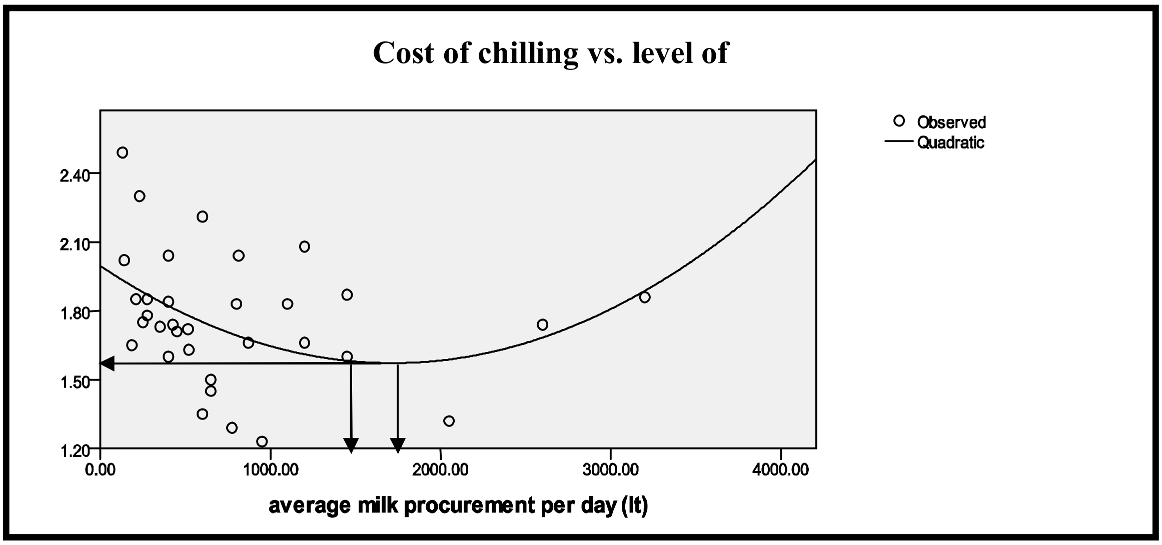


Figure 4.6: Variation of chilling cost w.r.t level of procurement

The figure 4.6 portrays that, the cost of chilling is optimal for the BMCs who are procuring between 1,500 and 1,800 litres of milk per day. The cost of chilling for these units is around Rs.1.58 per litre of milk. It is depicted in the figure that the cost of chilling falls from the highest value of Rs.2.49 (maximum) to Rs.1.23 (minimum) with a mean of Rs.1.76 and standard deviation of Rs.0.28. The estimated curve though does not take into account all the observations still considers maximum of them to fit this curve. From the figure 4.6 the minimum cost of chilling is presumed to be Rs.1.58 per litre which is above the calculated figure of Rs.1.23. It is also depicted that beyond 2,000 litre milk procurement, the cost of chilling again takes an upward trend due to high cost of electricity and fuel (in power-cut situations).

4.3.9 Cost of chilling vs. various expenses

We have already seen variation of chilling cost with respect to the procurement. The higher is the collections the lower is the chilling till 1,800 litres which rises further with the increase in collection. In order to see the influence of the other variables the multiple regression technique has been applied – the details are as follows. It considers all kinds of expenses incurred in the day to day business of the BMCs.

Table 4.28.2: Model summary of chilling cost vs. other expenses

R	R square	Adjusted R square	Std. error of the estimate	Durbin-Watson
0.85	0.72	0.63	0.17	1.89

About 72 percent of the variability in the cost of milk production could be attributed to the variables mentioned in the coefficient table 4.28.2 while representing the population at the level of 63 percent (Adjusted R square). The Durbin-Watson statistic says here that, there is a positive auto-correlation exists among the independent variables.

Table 4.28.3: ANOVA for chilling cost vs. other expenses

Statistics	Sum of squares	df	Mean square	F	Sig.
Regression	1.83	8	0.23	7.73	0.00
Residual	0.71	24	0.03		
Total	2.54	32			

The independent variables do a good job in defining the dependent variable. Since "p value" is less than 0.05, the independent variables are statistically significant for bringing out variability in the cost of chilling.

Table 4.28.4: Regression coefficients of chilling cost vs. other expenses

Independent variables	Unstd. coeff (B)	Std. error	Std. coeff (β)	t statistic	Sig.	Toleran.	VIF
Constant	1.67	0.12	-	14.22	0.00	-	-
Secretary commission	0.00	0.00	-4.72	-6.57	0.00*	0.12	8.32
Salary and wages	0.00	0.00	1.82	4.42	0.00*	0.07	14.55
House rent	0.00	0.00	0.48	1.99	0.06	0.20	5.02
Electricity charges	0.00	0.00	0.15	0.73	0.48	0.27	3.70
Transportation cost	0.00	0.00	2.24	5.63	0.00*	0.07	13.64
Maintenance cost	0.00	0.00	0.15	0.71	0.49	0.27	3.74
Miscellaneous costs	0.00	0.00	0.33	1.17	0.25	0.15	6.90
Depreciation	0.00	0.00	0.66	1.96	0.06	0.10	9.60

*significant at five percent level

Out of the above independent variables, it is concluded that the commissions, "salary and wages" and transportation cost are significant variables. Though electricity cost is not statistically significant (at five percent level), still it is one of the major expenses for the chilling milk to save it from damage (curdling). There exists a low multi-collinearity for variables like "salary & wages" and transportation costs. Though it is an undesirable situation still can't be ruled out to calculate the cost of chilling and dispatching it to the production plant for processing. This could be due to the closeness of the values among the BMCs which lead to the undesirable situation to some extent.

4.3.10 Cost breakup for operational costs

From the earlier discussion, we have seen that the cost of collection and transportation is Rs. 1.76 per litre which is accounted for the cost of chilling in aggregate. The breakup of mean cost of chilling (operational) that is Rs.1.76 is mentioned in the table 4.29.

Table 4.29: Operational cost breakup at bulk milk coolers

Heads of cost	Cost/lt (Rs.)
Transportation cost	0.57 (32.0)
Salary and wages	0.44 (25.0)
Secretary commission	0.33 (19.0)
Electricity cost	0.32 (18.0)
Maintenance and misc. cost	0.07 (4.0)
House rent	0.02 (1.0)
Depreciation	0.01 (1.0)
Total	1.76 (100.0)

Transportation is the major cost head accounting for 32 percent of the total operational costs followed by "salary and wages" (25 percent) and secretary commission (19 percent). Electricity (chilling) cost is another major head of expense accounting for 18 percent and all other expenses (maintenance and miscellaneous, house rent and depreciation) constitute six percent of the total operational costs. Depreciation is calculated on building only by taking a 50 years life span thereto at the rate of 10 percent per annum. Depreciation of machineries is not being taken into account since they have been financed by several agencies to the federation or union. The later parts of the variables in the table are minor figures and hence are insignificant as stated earlier in the multiple-regression segment.

4.3.11 Profit and ROI

After meeting the day to day expenses the profit has been calculated at the end of the table followed by the ROI. The table 4.30 refers to the general statistics of the profit and ROI for the BMCs.

Table 4.30: Profit and ROI of bulk milk coolers

Statistics	Profit per annum (Rs.)	ROI (percent)
Mean	46,590	4.6
Std. deviation	103,864	9.3
Minimum	-98,244	-7.4
Maximum	451,620	25.7
Sum	1,537,452	5.6 (mean)

It is seen that the net profit is found to be positive whereas some of the BMCs are found to be incurring losses and some are at the breakeven point. There are 13 BMCs, who are incurring losses and hence the ROI is found to be negative in those cases. Another 13 BMCs are making profit with their respective ROIs varying till 25.7 percent with a mean of 4.6 percent. The rest are making higher profits comparing to the earlier ones having a two digit return on investment. This shows sound business operations in their case. The lack of profitability and negative return on investment can be attributed to the lack of procurement. The monthly profit from all 48 BMCs are found to be Rs.186,336 with a mean BMC-profit of Rs.3,882 (approximately). The overall return on investment irrespective of the operational and profitable BMCs is found to be 5.6 percent which is reported to be a decent figure for the milk unions.

4.3.12 Hypotheses at bulk milk cooler level

(i) The larger is the operational area the higher is the level of procurement: The p value from the regression analysis for this particular variable is seen to be 0.13 which is more than 0.05 and hence the idea is deemed to be rejected. Mere increase of the operational area with low commitment level of the stakeholders does not really work (table 4.22).

(ii) The larger is the DCS base the higher is the level of procurement: The statement is supported in this case ($p = 0.04 < 0.05$). Already it is seen that the dairy cooperative societies collect around 100 litres of milk per day (average) which is definitely a value addition to the operation of the bulk milk coolers (table 4.22).

(iii) The higher is the milk producer participation (active members) the higher is the quantum of procurement: In the previous segment of the dairy cooperative societies the hypothesis is seen to be accepted. In this case the statement is also supported at five percent level ($p = 0.00 < 0.05$) of significance (table 4.22).

(iv) The higher is the level of procurement the lower is the cost of chilling: The assumption is found to be rejected at five percent level of significance if the collection is beyond 1,800 litres per day ($p = 0.08 > 0.05$). Though it is true till the collection level of 1,800 litres yet beyond this point the argument is not valid out and out so the hypothesis is partially accepted (figure 4.6).

4.4 Conclusion

After a thorough revision of the chapter it is concluded that procurement function of the supply chain is not adding value to it and hence lot of pre-cautionary measures are required to be taken to improve it. Especially at the level of milk production and chilling, being the two vulnerable components, a great deal of care is required to improve production of milk and its flow to the chilling centres through dairy cooperative societies. Milk producers should be trained and educated on regular intervals to manage their cost of productions.

4.5 References

Department of Animal Husbandry, Dairying and Fisheries, Government of India. (2009). *Dairy Statistics*. New Delhi: Author. Retrieved December 7, 2008, from http://www.dahd.nic.in/

Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1998). *Multivariate data analysis*. London: Prentice Hall.

Saravanakumar, V., & Jain, D. K. (2008). Economic analysis of milk production in Tamil Nadu. *Productivity, 48*(4), 408-414.

Thirunavukkarasu, D., & Sudeepkumar, N. K. (2006). Comparative profile of milk producers in different marketing systems. *Journal of Rural Development, 25*(1). 49-65.

CHAPTER V

ONGOING SCM PRACTICES: PRODUCTION & DISTRIBUTION FUNCTIONS

In this chapter the production and distribution functions of the supply chain have been discussed ranging from the production plant to the customers through the retail outlets. Cost of milk processing, out-bound logistics, retailing of products, customers' purchasing pattern and satisfaction etc. have been elaborately discussed. Profit and return on investment (ROI), with due consideration to the overall expenditure, have been calculated at each level (excepting the customer) to sketch the financial status of individual stakeholders in the system so as to detect the financial soundness of the supply chain on the down-stream.

5.1 Processing at the Production Plant

The basic profile of the production plant has been mentioned in the research methodology part of chapter I. The table 5.1 is indicating the capacity utilisation of various machineries of the production plant.

Table 5.1: Capacity utilisation of plant machineries

Name of the products	Unit/time	Existing capacity	Present throughput	Capacity utilisation (%)
Liquid milk	Litres/day	50,000	35,000	70
Butter milk sip	Packets/day	20,000	15,000	75
Sweet curd	Kgs/month	20,000	15,000	75
Plain curd	Kgs/month	50,000	40,000	80
Chhenapoda	Kgs/month	2,000	1,800	90
Flavoured milk	Bottles/month	18,000	12,000	67
Paneer	MT/month	10	10	100

Except paneer the production capacities of the various products have been under-utilised so far. Though there is a tremendous potential for the dairy to grow due to lack of milk procurement it's unable to produce the desired quantity of the products ultimately putting the capacity utilisation at a lower level. In certain cases due to lack of demand for a particular product in the respective operational area the production is adjusted to match the supply and demand. But above all especially in the lean season the production plants suffer due to lack of procurement and hence the production processes for the various products get hampered. The table 5.2 depicts the mismatch between the procurement and marketing indicating the lower level of marketing.

Table 5.2: Procurement vs. marketing at production plant

Months (2008-09)	Milk procurement/ day (lt)	Milk marketing/ day (lt)	Milk used for products/ day (lt)	Total milk requirements/ day (lt)	Procurement – marketing/ day (lt)
December	28,199	30,799	2,851	33,650	-5,451
January	27,301	32,710	2,909	35,619	-8,318
February	26,868	34,642	4,090	38,732	-11,864
March	29,913	34,546	5,016	39,562	-9,649
April	31,409	33,472	7,759	41,231	-9,822
May	30,496	31,724	6,801	38,525	-8,029
June	29,198	31,713	6,592	38,305	-9,107
Average	29,055	32,801	5,145	37,946	-8,891

Over the last seven months in the year 2008-09, the above table depicts the milk marketing versus procurement. There is a gap noticed in the process which is compelling the dairy to add SMP (skimmed milk powder) to manage it. It can be noticed that, the average procurement over the mentioned period is found to be 29,055 litre per day out of which 5,145 litres is kept for manufacturing of the various dairy products and the rest is processed for packaged milk through pasteurisation. On an average, where there is a need of 37,946 litres of milk per day, only 29,055 litres is procured from the procurement chain with a shortage of 8,891 litres of milk.

The shortage of milk is compensated with the SMP of other brands and added to the liquid milk with water to fill the gap. Though it brings up the necessary requirement of the firm, still in certain cases decreases the total milk solids deteriorating the quality of milk and increasing the cost of processing. During the dry period of cattle and shortage of green fodder especially in the summer, the procurement decreases substantially leading to serious problems in production – leading to stoppage of production of some of the products. At any cost, the liquid milk selling is not compromised due to lack of procurement keeping view to its requirement by the consumers being an ethical issue of the firm and the federation to serve the urban people. The procured milk is processed to produce various products. As long as milk is concerned there are two different kinds of packaged milk is available in the market namely toned and double toned milks.

The very names are based upon the level of solid contents of milk. Toned milk contains 3.0 percent fat and 8.5 percent SNF whereas double toned milk contains 1.5 percent fat and 8.5 percent SNF which gives low level of cholesterol. Due to unavailability of data for other products, the production cost for toned milk is discussed below (table 5.3).

5.1.1 Cost of milk processing

Table 5.3: Cost of processing per litre (Toned milk)

Heads of cost	2007	2009*
	Rs.	Rs.
Fat cost (3.0 percent)	3.37 (21.4)	4.62 (21.2)
SNF cost (8.5 percent)	4.79 (30.4)	9.60 (44.0)
Skimmed milk powder cost	4.05 (25.7)	4.05 (18.6)
Process loss (2.0 percent)	0.24 (1.5)	0.24 (1.1)
Raw material cost	**12.45 (79.1)**	**18.51 (84.9)**
Production cost	0.71 (4.5)	0.71 (3.3)
Distribution cost	0.51 (3.2)	0.51 (2.3)
Depreciation	0.21 (1.3)	0.21 (1.0)
Loss in transit (1.0 percent)	0.16 (1.0)	0.16 (0.7)
Agents' insurance	0.05 (0.3)	0.05 (0.2)
Interests on loans	0.03 (0.2)	0.03 (0.1)
Miscellaneous cost	0.06 (0.4)	0.06 (0.3)
Processing cost	**1.73 (11.0)**	**1.73 (7.9)**
Administrative cost	**1.00 (6.4)**	**1.00 (4.6)**
Packaging cost	**0.56 (3.6)**	**0.56 (2.6)**
Total cost	**15.74 (100.0)**	**21.80 (100.0)**

*2009 is based upon current fat & SNF prices

The cost of production of every product is a very crucial aspect of the plant. In most literature it is conveyed that the procurement cost of the raw material is the highest among all production parameters which is a no deviation in this case. On an average 60 per cent of organisations' sales income is invested in material acquisitions (Tiersten, 1989). This is an indicative reference and hence the figures vary from cases to cases, industry to industry. It is seen from the above table 5.3 that, raw material only costs as high as 80 percent of the total cost of production followed processing cost. In the year 2007, the raw material cost is found to be around 79 percent and later on it increases up to 85 percent of the total cost. The reverse figure is retrieved for the processing cost which says, it decreases from 11 percent (2007) to eight percent (2009).

The rest of the expenses are incurred for various other heads like administrative costs and packaging costs etc. - the details of the various cost heads are specified in the table. It can be seen that liquid milk sale is a loss making product where the cost of production is higher than the retail price.

To strengthen the arguments a study made by Chauhan, Dhaka, Singh, Chandel and Sharma (2006) has been represented here. This depicts the figures for the cost of production for dairy products. After a thorough look on the figures of cost of production it is inferred that raw material (78 percent) and packaging (13 percent) are the highest ones; together responsible for more than 90 percent of the total cost of production.

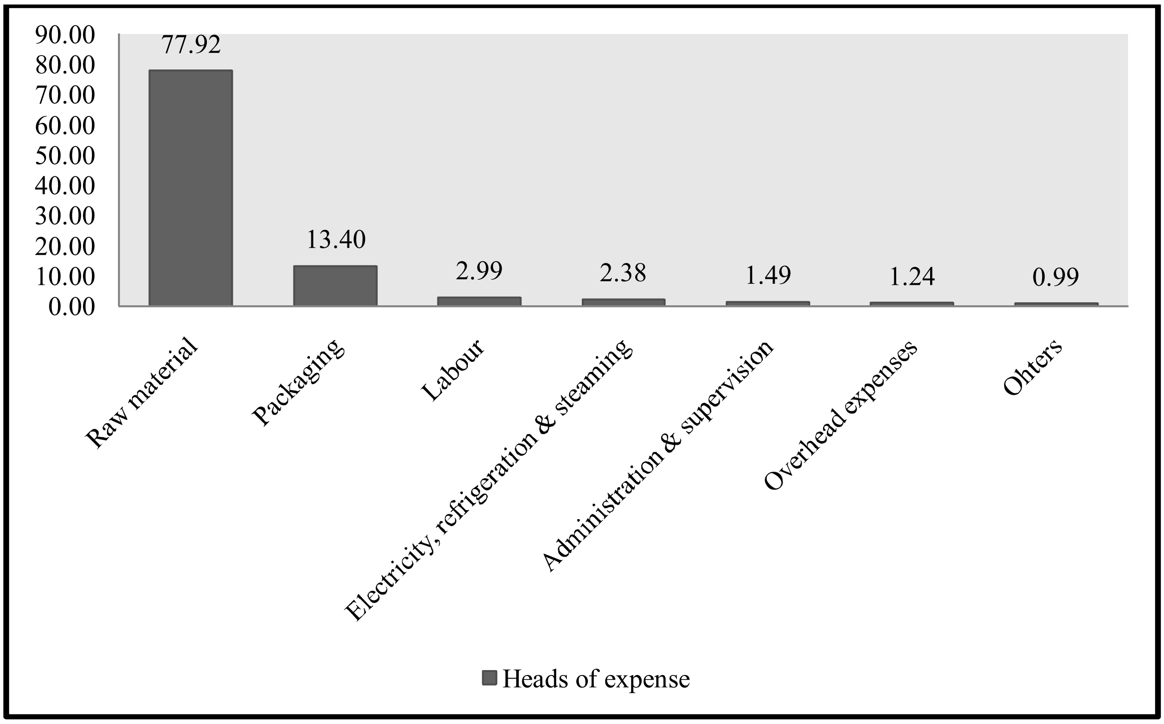


Figure 5.1: Factors of cost of production for dairy products

Source: Chauhan, Dhaka, Singh, Chandel and Sharma (2006)

Table 5.4: Cost of production of various dairy products (figures in bracket are in percent)

Cost components	Full cream milk/lt	Standardised Milk/lt	Toned Milk/lt	Double toned milk/lt	Skimmed Milk/lt	Sweet flavoured milk/200 ml	Paneer/kg	Ghee/905 gm	Sweet lassi/200 ml	Salty lassi/250 ml	Dahi/200 ml
Raw material	14.56 (91.17)	12.26 (90.60)	10.55 (90.10)	9.32 (90.06)	8.20 (89.81)	2.50 (44.33)	69.56 (94.37)	108.93 (87.66)	2.13 (52.72)	2.01 (65.47)	2.38 (60.87)
Labour	0.19 (1.19)	0.16 (1.18)	0.10 (0.85)	0.06 (0.58)	0.04 (0.44)	0.25 (4.44)	0.95 (1.29)	1.61 (1.30)	0.24 (5.94)	0.30 (9.77)	0.23 (5.88)
Electricity	0.08 (0.50)	0.08 (0.59)	0.06 (0.51)	0.05 (0.48)	0.04 (0.44)	0.13 (2.30)	0.23 (0.31)	1.91 (1.54)	0.03 (0.74)	0.03 (0.98)	0.01 (0.26)
Water	0.02 (0.13)	0.02 (0.15)	0.02 (0.17)	0.02 (0.19)	0.02 (0.22)	0.01 (0.18)	0.12 (0.16)	0.46 (0.37)	0.01 (0.25)	0.01 (0.33)	0.01 (0.26)
Steam	0.10 (0.63)	0.09 (0.67)	0.09 (0.77)	0.09 (0.87)	0.09 (0.99)	0.05 (0.88)	0.12 (0.16)	0.65 (0.52)	0.01 (0.25)	0.01 (0.33)	0.02 (0.51)
Refrigeration	0.19 (1.19)	0.17 (1.26)	0.17 (1.45)	0.17 (1.64)	0.16 (1.75)	-	0.24 (0.33)	0.65 (0.52)	0.03 (0.74)	0.01 (0.33)	0.03 (0.77)
Quality control	0.09 (0.56)	0.07 (0.52)	0.05 (0.43)	0.02 (0.19)	0.02 (0.22)	0.01 (0.18)	0.19 (0.26)	1.52 (1.22)	0.01 (0.25)	0.01 (0.33)	0.01 (0.26)
Miscellaneous	0.06 (0.38)	0.04 (0.30)	0.03 (0.26)	0.02 (0.19)	0.02 (0.22)	0.01 (0.18)	0.08 (0.11)	0.95 (0.77)	0.02 (0.50)	0.02 (0.65)	0.02 (0.51)
Packaging	0.34 (2.00)	0.34 (2.51)	0.34 (2.90)	0.34 (3.29)	0.34 (3.72)	2.60 (46.10)	0.25 (0.34)	1.62 (1.30)	1.53 (37.87)	0.63 (20.52)	1.05 (26.85)
Administration & supervision	0.26 (1.75)	0.23 (1.70)	0.21 (1.79)	0.20 (1.93)	0.16 (1.75)	0.02 (0.35)	1.02 (1.38)	4.10 (3.30)	0.04 (0.99)	0.02 (0.65)	0.03 (0.77)
Overhead expenses	0.08 (0.50)	0.07 (0.52)	0.09 (0.77)	0.06 (0.58)	0.04 (0.44)	0.06 (1.06)	0.95 (1.29)	1.87 (1.50)	0.09 (2.23)	0.05 (1.63)	0.12 (3.07)
Total	15.97 (100.00)	13.53 (100.00)	11.71 (100.00)	10.35 (100.00)	9.13 (100.00)	5.64 (100.00)	73.71 (100.00)	124.27 (100.00)	4.04 (100.00)	3.07 (100.00)	3.91 (100.00)

Source: Chauhan, Dhaka, Singh, Chandel and Sharma (2006)

National Dairy Research Institute (2001-02), as cited in Elumalai and Sharma (2008), also discusses the cost of production for the skimmed milk powder (SMP), butter and ghee. It also confirms that the mean raw material cost is more than 80 percent of the total cost of production. Other costs depend upon the nature of the products to be manufactured. In Skimmed milk powder, steaming is another major cost followed by the raw materials – this two cost heads accounts for more than 90 percent of the total cost of production. Similarly for ghee and butter next to the raw material it is the “administrative & supervision” costs which found to be around 10 percent of the cost of production. Depreciation of machineries and the labour are also detected to be two other cost heads in the production process.

5.1.2 Price of various products fixed by the federation/plant

Keeping view to the cost of production, cost plus method of pricing is adopted to price various products. The following are the retail price for various products (product line) of which some are manufactured at the respective production plant where as products like ghee and table butter etc. are being procured from the Bhubaneswar dairy to appease the tastes and preferences of the customers.

Table 5.5: Prices of dairy product and profit at retailer level

Name of the of products	Contents	Units	Retail prices	Customer prices	Profit/ unit
Milk (per litre)	500 ml	Pouch	19.30	20.00	0.70
Whole milk curd (WMC)	500 gm	Pouch	13.00	15.00	2.00
Butter milk sip (BMS)	250 gm	Pouch	4.00	5.00	1.00
Lassi	250 gm	Pouch	4.80	6.00	1.20
Table butter	100 gm	Packet	15.50	18.00	2.50
Chhenapoda	100 gm	Packet	10.00	12.00	2.00
Chhenapoda	250 gm	Packet	23.00	27.00	4.00
Chhenapoda	500 gm	Packet	44.00	50.00	6.00
Paneer	200 gm	Packet	29.07	31.00	1.93
Paneer	500 gm	Packet	71.16	75.00	3.84
Paneer	10 kg	Packet	132.00	132.00	0.00
Skimmed milk powder	200 gm	Packet	32.50	37.00	4.50
Skimmed flavoured milk	200 ml	Bottle	10.75	12.00	1.25
Cold coffee	200 ml	Bottle	11.75	13.00	1.25
Sweet curd	80 gm	Cup	5.80	7.00	1.20
Plain curd	200 gm	Cup	11.00	13.00	2.00
Plain curd	500 gm	Cup	22.00	26.00	4.00
Kheera	100 gm	Cup	12.00	14.00	2.00
Kheera	50 gm	Cup	8.00	10.00	2.00
Ghee	1 litre	Jar	236.00	256.00	20.00
Ghee	500 ml	Jar	122.00	132.00	10.00
Ghee	200 ml	Jar	52.00	55.00	3.00
Ghee	15 kg	Tin jar	2950.00	2950.00	0.00

Source: Orissa State Cooperative Milk Producers’ Federation (2009)

Most of the products mentioned in the table 5.5 are perishable in nature and need to be moved very fast in the distribution chain. That's the reason why a two-tier distribution system is preferably applied to facilitate it in the market place. The various products exhaustively produced and marketed by the federation are mentioned in the table with their usual descriptions and profit thereto at the retailer level.

The profit made from selling one litre of packaged milk (two pouches) at the counter is Rs.0.70 whereas additional Re.1 is charged per litre if ordered from home. For the dairy products like paneer (10 kg block) and ghee (15 kg tin pack), the retailers won't make any profits out of these and is sold at the interest of the customers. This is usually meant for the industrial usages like hotels and restaurants, which purchase the products in bulk amount. For all other products, retailers make profit in varying degrees which is depicted in the last column of the table.

5.1.3 Quality and Safety Issues

The safety aspects of the plant covers three basic constituents namely men, machineries and materials. Adequate measures are being taken by the plant to prevent hazardous incidents which are intact in the production processes.

5.1.3A: Safety issues relating to personnel

In case of men, it has been seen that most of the hazardous incidents are being created by carelessness and improper handling of the machineries. Furthermore some of the other threats could be:

- Leakage of ammonia from the refrigerators
- Due to excessive use of water/fuel - floors become slippery
- Storing of materials in front of electrical panels
- Improper lighting system at the working places
- Blocking entry/exit points with materials
- Wild vegetations around/inside the plant due to water use
- Non-protective/unlabelled electrical wirings
- Un-earthening of motors and other electrical instruments etc.

Awareness and proper handling of machineries could substantially prevent most of hazardous incidents related to the production processes. Moreover use of gas masks, cleaning of floor with sodium hypo-chloride solution on regular basis and proper wiring procedure are some of the major precautions taken to prevent potential hazard risks.

5.1.3B: Safety issues relating to machines

Adequate preventive maintenance programme (PMP) is undertaken for stopping of risks relating to the machineries. The basic objective of the programme is to stop hazards relating to the machineries and equipments. More specifically it is undertaken to prevent machineries failure with the following objectives:

- Avoiding interruptions in production/processing by minimising loss
- Curbing large scale repairs by regular maintenance
- Cost reduction and identifying susceptible areas of production failure
- Maintaining a safety environment through various training/awareness programmes

5.1.3C: Safety issues relating to materials

Milk being one of the highly perishable substances, utmost care has been taken in this connection to prevent products from all sorts of damages (biological, chemical and physical). In order to ensure the products to be safe for consumption before it goes to the market, adequate preventive measures are being taken by the plant officials. Some of the major methods of fool-proofing are Hazard Analysis and Critical Control Point (HACCP), ISO-9000 and Good Manufacturing Practice (GMP) etc. which ensure quality and safety at all critical areas of production. While some of the practices from all these standards are yet to be followed in the organisation, in order to ensure safety and quality, the following measures are being undertaken:

- Clean milk production programme (CMP) to ensure safety at the milk producers' level
- Stringent cleaning and sanitation regulations at the chilling centres and dairy plant
- Use of headgears, masks, gloves, safety shoes etc. to maintain clean environment a
- Micro-biological tests, chemical tests etc. are carried out in the laboratory to ensure product safety and quality

5.1.4 Sales of various products

Currently the liquid milk market is estimated to be around 60,000 litres per day (approximately), out of which 50 percent is shared by the dairy while the informal milk market contributes to 45 percent of the same and the rest is shared by the private firms. In case of organised milk marketing, it is the dairy which contributes to more than 90 percent of the market while less than 10 percent of the market is captured by the private dairy processors. This is made possible after deregulation of the milk market during 1991 when the private parties allowed in this sector. But due to higher trust on the cooperative based dairies, the customers are leaned more towards the federation. So far private firms are not playing any significant role in the state in milk processing and distribution.

Table 5.6: Year-wise sales of dairy products at production plant

Dairy products	Unit	2004-05	2005-06	2006-07	2007-08	2008-09	CAGR (percent)
Liquid milk	'000 lts	14,993	17,616	22,755	26,875	30,596	15.33
Ghee*	Kgs	19,461	36,229	30,192	63,886	28,997	8.30
Sweet curd	Kgs	33,270	115,471	126,621	145,032	118,511	28.93
Plain curd/WMC	Kgs	75,300	203,921	295,195	413,830	499,168	45.98
Butter milk sip	Packets	243,371	903,126	944,458	957,114	1,195,292	37.48
Flavoured milk	Bottles	80,415	79,764	70,040	79,673	83,575	0.77
Milk powder*	Kgs	-	1,502	289	468	2,889	13.98
Paneer	Kgs	-	44,664	45,541	53,778	90,602	15.20
Kheera	Kgs	-	6,630	6,693	5,639	4,454	-7.65
Table butter*	Kgs	-	937	605	877	704	-5.56
Chhenapoda	Kgs	-	-	3,946	5,014	6,581	10.77
Lassi	Packets	-	-	-	-	87,678	-

*supplied from Bhubaneswar dairy

Over the period of last five years (2004-09) the liquid milk sale is increased by a compounded annual growth rate (CAGR) of 15.33 percent while it is 13.85 percent over the last year (2007-09). Ghee sales have gone up by 8.30 percent from 2004-05 to 2008-09 whereas sweet curd and plain curd/whole milk curd (WMC) sales have gone up by 28.93 and 45.98 percent respectively. It is seen that the plain curd/WMC has the highest growth in the last five years and the trend is also found to be positive. Butter milk sip has also the same trend with a CAGR of 37.48 percent over a period of last five years. Flavoured milk has got a stagnant growth of 0.77 percent since the product does not have substantial demand in the market place.

Furthermore kheera and table butter show the same trend like flavoured milk. It may be mentioned that the milk powder and table butter are being supplied by the Bhubaneswar dairy where the Balasore dairy takes care of the marketing the same in the designated areas. Due to lack of quality and availability of good brands like Amul, Nestle and Britannia the milk powder of OMFED is not much accepted by the customers so far and is being not produced by the Bhubaneswar dairy. Slightly, the innovative products like chhenapoda and peda are getting popular and are being produced from various dairies.

Table 5.6.1: Route-wise distribution of milk

Marketing routes	Average liquid milk sale/day (litres)					CAGR (percent)
	2004-05	2005-06	2006-07	2007-08	2008-09	
Balasore	5,505	5,526	6,414	7,690	8,669	9.51
Jaleswar	505	793	1,107	1,278	1,417	22.92
Soro	1,746	1,861	2,323	2,604	2,885	10.57
Nilgiri-Udala	719	910	1,339	1,736	1,954	22.13
Bhadrak	3,148	4,110	5,631	6,276	8,556	22.14
Chandbali	629	713	803	1,507	988	9.45
Mayurbhanj	2,741	3,703	5,138	5,784	6,127	17.45
Dairy total	14,993	17,616	22,755	26,875	30,596	15.33

During the last five years the (CAGR) in liquid milk marketing is found to be 15.33 percent whereas the highest growth is detected in case of Jaleswar (22.92 percent), Bhadrak (22.14 percent) and Nilgiri-Udala (22.13 percent). Being a tribally dominated area Mayurbhanj is also responding well to milk marketing of the dairy over a period of time (17.45 percent).

Other marketing routes are seen to be growing and to some extent they need attention of the marketing authorities for further improvements. It is also confessed by the authorities that due to longer distances some of the markets are not being served as desired. Some cases due to the warehousing problems perishability occurs leading to loss of time and resources. Irrespective of so many obstacles the dairy is growing at the rate of 10 percent annually.

5.1.5 Dairy-wise milk marketing per day

The federation is marketing around 300,000 litres of milk per day to fulfil the demand of the customers in the state. The following table depicts the dairy-wise milk marketing status in the state with their growths.

Table 5.7: Dairy-wise milk marketing per day

Dairy plants	2005-06	2006-07	2007-08	2008-09	CAGR
Balasore	18,891	23,626	28,066	32,439	11.42
Berhampur	12,470	14,788	15,931	17,954	7.56
Bhawanipatna	3,139	4,381	5,861	5,840	13.22
Bhubaneswar	104,717	118,871	128,710	131,949	4.73
Dhenkanal	10,986	12,155	13,626	14,314	5.43
Jaipur	4,871	5,087	6,492	4,682	-0.79
Keonjhar	12,200	12,056	15,026	13,992	2.78
Rourkela	16,839	20,847	23,439	24,808	8.06
Sambalpur	20,430	22,420	26,035	28,425	6.83

Source: Compiled from MIS reports of OMFED

The details of milk marketing of nine dairies are available of which there is a remarkable growth depicted in case of Bhawanipatna dairy (13.22) and Balasore dairy (11.42). As stated earlier that the later is growing at the rate of 10 percent is confirmed in this case. Even Bhubaneswar dairy which is operating in major areas of the state and producing additional items has not made any substantial growth in case of liquid milk marketing. Rourkela dairy is also doing better than the remaining ones being at third position in milk marketing. Other facts of these dairies are not available hence the product-wise growth is not possible to be depicted here.

5.1.6 Financial status of the plant

The production plant had been operating under the control of the milk union and later on in early 2000s it got handed over to the dairy federation. The initial outlay of the plant which was Rs.100 millions has now reached at Rs.241 millions. The plant has emerged as one of the major production plants for the dairy federation serving three major districts namely Bhadrak, Balasore and Mayurbhanj with a vast geographical area of 16,729 sq kms.

The assets and liabilities of the plant from 2004-05 to 2007-08 has been mentioned which shows the growth of the plant over a period of four years.

Table 5.8: Assets and liabilities of the production plant (audited report)

Particulars	2004-05	2005-06	2006-07	2007-08
Assets (Rs. millions)				
Fixed assets	1.57	1.79	1.76	4.51
Capital WIP	0.19	0.5	3.12	3.42
Inventories	1.32	2.52	6.06	3.88
Trade debtors	0.48	0.56	0.72	1.01
Loans and advances	56.17	84.2	131.59	221.58
Cash & bank balance	3.05	3.52	6.42	6.94
Total	62.77	93.09	149.66	241.34
Liabilities (Rs. millions)				
Share capital (statutory reserve)	0.46	0.53	2.16	17.53
Current liabilities	62.31	92.56	147.5	223.81
Total	62.77	93.08	149.66	241.34

Source: OMFED finance section (2008)

The main sponsors of the plant today are the Government of India and Orissa State Cooperative Milk Producers' Federation. Over a period of last 10 years the plant has shown a Compounded Annual Growth Rate (CAGR) of nine percent in the fixed assets and is under further expansion to cater the need of five million people.

5.2 Transportation by Third Party Logistics Providers (TPLP)

Transportation plays a vital role in the effective and efficient performance of the supply chain. Today, in order to minimise the supply chain costs most of the activities of the firms have been outsourced. One of this could be the transportation function of the firm. This is in accordance with the competitive strategy which the firms go on changing from time to time. In order to cope with the competitive environment, some of the firms are considering having a combination of both in-house and outsourced transportation. This is greatly influenced by the firm's nature of business and the size of the shipment. For the firms, where the shipment sizes are large it is a wise decision to go for in-house transportation.

On the contrary if the firm's shipment sizes are relatively small it is better to outsource the activity. In the later case the outsourced method of transportation found to be handy because of the fact of under-utilisation of the in-house transportation resources. In this case once the shipments have been made and goods delivered, the resources found to be obsolete for the rest of day causing under-utilisation thereto. This is once again a complex activity when the firm deals with such materials and the products which are highly perishable in nature. It causes a great loss if these are not delivered at the right time and right place.

Transporting such items not only depend upon the agility of the supply chain rather depends upon the proper mode of storage and warehousing. Whereas for the inbound logistics, sterilised tankers are used, insulated vehicles are used for the distribution purposes thereto. This complex activity is basically time bound essentially utilising a faster movement of goods which are not to be detained en-route. Keeping view to all this, proper transportation decision has to be made in order to see the stakeholders in the system served in time at the right place. Orissa State Cooperative Milk Producers' Federation is among one of the federations in the country which basically has outsourced most of its logistical activities.

5.2.1 Pre-requisite for a prospective third party logistics provider

The dairy invites sealed tenders from the prospective transporters for distribution of products from the dairy to its retailers scattered over the three operational districts. There is an Earnest Money Deposit of Rs.3,000 (EMD) demanded from the prospective bidder and upon remaining unsuccessful the amount is returned back to them. On the contrary, the successful bidder's EMD is kept as a security deposit and is returned to hem/her upon successful completion of the contract. This contract has been initially for a period of three years and can be extended as per the rules of the dairy changing from time to time.

The three years flexible non-transferable agreement is made between the Managing Director or any other authorised officer of the federation and successful bidder. The vehicles required for the transportation need to be properly insulated as per the specifications made by the firm. The vehicles which are not insulated are required to be insulated within one month of the order issued to the successful bidder. Both the parties can disengage themselves from the contract after serving due notice to the each other. But till the alternative arrangement, the concerned transporter will have to be on the route for the distribution activities.

5.2.2 Operating cost for transportation

The out-bound logistics are provided by two third party logistics providers (3PLs) namely; Panda and Sabitri transporting agencies. These two transporting agencies manage the whole out-bound logistics and help the production plant in various other distribution related issues. The production plant and the 3PLs maintain a high level of coordination among them to facilitate the delivery process and maximising the customer satisfaction.

The various factors which are responsible for the aggregate transportation costs are fuel, maintenance, salary, trip related costs etc. The data collected from the two major transporting agencies are complied to reach at the operating cost per km. It may be noted here that, for transportation the fuel, depreciation and maintenance costs account for around 70 percent of the total operating costs. The other costs according to their weightage have been mentioned in the table below.

Table 5.9: Factors affecting transporting cost

Factors of transportation	Rs./km
Fuel cost	2.91 (40.6)
Interests	1.07 (15.0)
Depreciation	1.07 (15.0)
Maintenance	0.97 (13.5)
Salary	0.52 (7.2)
Overheads	0.26 (3.6)
Trip related cost	0.19 (2.7)
Tax and insurance	0.16 (2.3)
Total	7.16 (100.0)

5.2.3 Receipts towards transportation cost from plant

Depending upon the vehicles' weight the security deposits are maintained with the production plant and accordingly as per the rules of the federation the amount is paid per km for transportation (details in the table). The higher the weight of the vehicle the higher is the security deposit demanded and the higher payment per km is also made at the same time. Recently the average price being paid for the transportation is Rs.7.60 per km with a minimum and maximum of Rs.5.77 and Rs.9.83 respectively.

Table 5.10: Vehicle categories with their price/km

Categories	Vehicle weight (tonne)	Security deposits (Rs.)	Price paid/km (Rs.)
1	Less than 0.7	4,000	3.96
2	0.7 - 1.0	6,000	5.99
3	1.0 – 1.5	8,000	5.99
4	1.5 – 3.0	10,000	6.86
5	More than 3.0	15,000	8.90

On the other side, the operating cost for out-bound transportation is found to be Rs.7.16/km where the receipt from the plant is Rs.7.60/km (average). In addition to the costs incurred by the 3rd parties to deliver the goods to the retail outlets, they get Rs.50/day extra towards their vehicle insulation charges which is a pre-requisite for the 3rd parties to hold the tender. On an average, for both in-bound and the out-bound logistics 5,000 kms is covered per day to get the products reach to the end users. The below given table depicts the details of the distribution process from the production plant to the retail outlets.

5.2.4 Distribution process

The vehicles generally report for the morning and evening distribution respectively as per the timings specified by the plant. Depending upon the distances covered on a typical route, the vehicles report the dock of the plant at least half an hour before to have loadings. In the morning schedule the vehicles report at 9.00 PM and continue to do the same till 2.00 AM depending on the distances they are to travel. For the morning distribution, the last retailer point should be touched upon by 5.00 AM. In the similar way, for the evening distribution the vehicles report the dock at around 11.30 AM and continue till 2.00 PM. The last distribution point in this case is delivered by 4.00 PM tentatively. The timings are fixed by the plant to curb delay in delivery process and impose penalty on 3PLs wherever needed to punish the defaulter for not meeting rules.

There are 22 vehicles operate in the distribution field and supply around 32,195 litres of milk per day to 287 odd retail outlets. In the entire process 2,716 kms is covered by the vehicles (to and fro) in two shifts (morning and evening) within 12 hours of time. There are places where once in a day, the products are distributed to the agents whereas other parts of the regions are supplied twice. All this depends upon the demand of the product in a particular region.

Table 5.11: Route-wise milk distribution

Major routes	Retail outlets (nos)	Milk sale/day (lts)	Distance travelled (kms)	Time required (hrs)	Vehicles in oper. (nos)	Transport cost/day (Rs.)	Transport cost/km (Rs.)	Transport cost/lt (Rs.)
Balasore	58	8,340	167	2.50	4	1,366.00	8.18	0.16
Jaleswar	18	1,640	160	8.00	1	1,057.60	6.61	0.64
Soro	28	3,380	328	6.00	2	2,425.00	6.22	0.72
Nilagiri	15	800	60	6.00	1	346.20	5.77	0.43
Bhadrak	32	5,480	576	5.50	3	5,501.00	9.55	1.00
Basudevpur	05	650	200	3.50	1	1,154.00	5.77	1.78
Dhamnagar	04	800	115	2.25	1	760.15	6.61	0.95
Baripada	40	4,460	324	5.00	3	3,185.00	9.83	0.71
Udala	18	1,160	219	5.00	1	1,447.59	6.61	1.25
Chandbali	16	1,305	135	3.50	1	778.95	5.77	0.60
Bant	09	1,210	92	3.00	1	530.84	5.77	0.44
Aradi	20	1,470	78	2.50	1	450.06	5.77	0.31
Jamsola	20	1,100	170	3.00	1	1,123.70	6.61	1.02
Rasgobindpur	04	400	92	2.50	1	530.84	5.77	1.33
Total	287	32,195	2,716	12.00	22	20,656.93	7.60*	0.64*

*average cost

Depending upon the demand and the carrying capacity of the vehicles, they are sent to the various locations to meet the retailers' requirements. In the above table the expenditure per day in the transportation process have been depicted with respect to the various roots. An amount of Rs.20,657 per day is expended towards transportation cost with an average of Rs.7.60 per km.

Further it can be seen that the average transportation cost per litre of milk is Rs.0.64 with a minimum and maximum of Rs.0.16 to Rs.1.78 respectively according to the distance covered by the vehicles with the products.

5.3 Milk Sales at Retailer Level

In order to be an authorised selling agent for the dairy products of the federation there are some regulations prevail upon which the agents should be agreed before taking the responsibility. The agreement is valid for one year and gets renewed year after year according to the level of their performance facilitating sales and other distribution issues of the concerned plant.

i. Health trade license should be obtained from local authorities to sell essential health-commodities like milk;

ii. Interest free security amount of Rs.1,000 for non-VAT (Value Added Tax) products and Rs.2,000 for VAT products should be kept deposited with the plant;

iii. Advance payment for the indents placed through cash or bank deposits and not placing of indent for a long time might lead to cancellation of agency;

iv. For the interest of the customers, the agents can't not charge more than Rs.150towards home delivery charges;

v. The agents might accept advance payment from the customers and should deliver products accordingly and

vi. Complaints from the customers will be viewed seriously – might lead to cancellation of agency and/or forfeiture of security deposits.

5.3.1 Retail operations

Once the distribution completes from the production plant now it is the turn of the retail agents who facilitate the products reach the end users. While milk is sold both at the counter and through home delivery other dairy products like paneer, ghee etc. are sold at the counter only. These days OMFED has set up its own parlours to facilitate selling still the main source of selling is through the retail agents who are geographically scattered to meet the requirement of its valued customers. The following discussion will be on the retailer-customer dyad which is the last segment of the supply chain.

Table 5.12: Retailing summary

Statistics	Years with the federation	Distance from the plant (kms)	Operational area (sq kms)
Mean	7.0	61.0	5.0
Minimum	0.5	0.5	0.5
Maximum	30.0	120.0	30.0

The table 5.12 depicts that mean years of retail-operation is just seven years wherein the minimum and maximum years of association with the company are respectively 0.5 years and as high as 30 years. It is further noticed that, two third of the retailers fall in the range of 0.5 to 7 years of association with the federation. The retail outlets which are scattered in various geographical regions found to be operating being at a maximum distance of 120 kms from the production plant. Since the products are highly perishable in nature and needs conditioned transportation, distributing in a circle of more than 120 km radius found to be a difficult task for the plant.

The mean distance of a retail outlet studied is found to be 61 km from the production plant with a minimum distance of 0.5 km being highly closed to it. Within the range of 50-100 kms more than half of the retailers are considered to identify the real problems with the logistics. The retailers who are close to the plant though studied (13 percent within 10 kms radius), the emphasis has been to cover the entire operational region. The mean operational area of a typical retailer is found to be five square kms, but some of them are found to be operating in a vast geographical region with an area of 30 square km approximately.

5.3.2 Sales of various products at retailer level

Table 5.13: Sales of various products per day

Statistics	Milk (lt)	Promot. milk (lt)	Counter milk (lt)	Home delivery (lt)	Sweet curd (cups)	WMC (cups)	Paneer (kg)	Chhen-apoda (kg)	Kheera (cups)	BMS (pouch)	Flavour milk (bottle)	Ghee (lt)
Mean	199.0	3.8	133.3	69.5	38.4	24.0	4.2	1.0	8.1	36.4	10.0	0.7
Minimum	10.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum	950.0	19.0	716.0	300.0	250.0	350.0	50.0	6.0	80.0	250.0	72.0	10.0

The products are usually seen to be sold by the retailers with varying degrees as per their demand in the region. Among all the products of the federation, it is the milk (toned), which has got a higher demand among all dairy products. The mean sale of milk by a typical retail outlet is seen to be close to 200 litres per day with a high standard deviation depicting a greater spread over the milk sales especially. In case of milk selling the federation has kept an incentive of one litre absolutely free, for every 50 litres of order. The promotional milk provision is meant for generating more sales and revenue which in turn attracts the retailers to order for more quantity. Above 90 percent of the cases, it is seen to have been ordered for more than 50 litres of milk with a maximum of 950 litres per day.

Out of the total milk received from the plant, it is seen that around 65 percent is sold at the counter whereas the rest is sold through home delivery. Among all dairy products being produced at the concerned dairy sweet curd, whole milk curd (WMC), paneer and butter milk sip (BMS) are the most popular ones which sell comparatively more than any other products. While there is an option to purchase milk from counter and home, the dairy products are sold at the respective parlours solely. The parlours are the retail outlets where milk as well as the dairy products is available unlike booth, which are only supposed to sell milk as per the memorandum of understanding between them and the federation. So booths are meant for non-value added tax (VAT) products whereas parlours sell both VAT and non-VAT products like milk.

According to the product prices for the retailers mentioned earlier the sales (Rs.) are calculated and tables are not depicted here to avoid exaggeration. From this calculation the minimum and maximum annual sales are found to be Rs.185,000 and Rs.9,522,600 respectively with an average of Rs.1,822,220. Since retailing of this kind of products is found to be a low investing and high profit making business concern, interest among the shopkeepers is quite prevalent to get the agency of the brand. With an average investment of Rs.45,000 annual sales turnover is found to be manifold in many cases which in turn making the business a profitable one. The table portrayed below is going to give a clearer description of the same.

5.3.3 Sales vs. demographics

Table 5.13.1: Correlation between sales and demographic characteristics

Sex	1.00									
Age	-0.15	1.00								
Education	-0.03	0.04	1.00							
Reason for retailing	0.00	-0.05	-0.03	1.00						
Total investments	0.13	-0.02	0.16	-0.22	1.00					
Total outlets	0.32	0.02	0.08	-0.08	0.34**	1.00				
Years with the company	0.22	0.09	0.04	0.06	-0.04	0.09	1.00			
Distance from the plant	-0.19	0.10	0.02	-0.07	0.00	-0.10	-0.07	1.00		
Operational area	0.06	-0.05	0.16	-0.05	0.23*	0.00	0.04	0.03	1.00	
Sales turnover	0.30**	-0.10	0.11	-0.04	0.35**	0.50**	0.02	-0.21**	0.11	1.00

* Significant at five percent, **significant at one percent levels

Unlike milk production which has been seen already a women-centric activity; selling of dairy products is a man centric activity (correlation of 0.30 at five percent level). Definitely higher investment leads to higher sales – found to be true with a correlation of 0.35 at the same level. But the factors like higher operational area ($p = 0.11 > 0.05$) found not to be influential in sales since demand is not increased with the increase in the operational area.

Among the negative factors the significant one is found to be the "distance from the plant" with a correlation level of -0.21. The rationale behind this is the lack of productions which does not allow the products sufficiently reach places with distances more than 50 kms from the production plant. In order to cover these areas it is essential to produce according to the operational area of the plant with adequate warehousing or transportation facility. For an instance the product ghee is found to be the most vulnerable one since the demand of it is much higher than the level of production. The lack of production is again attributed to the low level of procurement of raw milk and in some cases the market research is also found to be inadequate.

5.3.4 Sales, expenses and profit

The figures in the first column are calculated from the sales figures and their respective profits meant for the retail outlets as stated in the pricing section of the production plant operation. Further the net expenses on monthly basis have been calculated to reach at the net profit before taxes.

Table 5.14: Sales, expenses and profit at retailer level

Statistics	Profit/ month (Rs.)	H.Rent/ month (Rs.)	Wages/ month (Rs.)	Elect/ month (Rs.)	Interest/ month (Rs.)	Deprec/ month (Rs.)	Misc/ month (Rs.)	Net profit /month (Rs.)
Mean	12,541	772	1,388	307	358	339	612	8,764
Minimum	1,704	200	400	100	83	83	0.00	644
Maximum	69,654	2,500	10,000	1,800	1,667	1,667	1,500	52,896

Profit per month is found to be 7-10 percent of the sales made during that period. The table above depicts the profit made from sales per month. The monthly average profit (before expenses) is seen to be Rs.12,541 with a minimum and maximum of Rs.1,704 and Rs.69,654 respectively. In order to calculate the net profit (before taxes), the various expenses have been considered viz. house rent, electricity charges, wages, interests on loan or opportunity cost, depreciation and miscellaneous expenses.

5.3.5 Distribution of expenses under various heads

It is found that 90 percent of the retailers are running their outlets by taking houses on rental basis (Rs.200 to Rs.2,500 per month) whereas the rests have got their own houses meant for the same purpose. Some (43 percent) of the retailers found running their businesses without hiring anybody whereas, the rests 57 percent have hired sales boys with wages ranging from Rs.400 to Rs.10,000 per month to facilitate selling. Having dealt with the perishable products, they are found to be expending from Rs.100 to Rs.1,800 per month towards electricity charges for freezing.

The mean electricity charges per month is seen to be Rs.300 (approx.) whereas Rs.700 is seemed to be expended for meeting interests and depreciation being taken together. The minimum and maximum expenses are found to be ranging from Rs.83 to Rs.1,667 per month, taken separately for the depreciation and interests on loan. In the similar way the miscellaneous expenses have gone up to the level of Rs.1,500, with an average of Rs.600 per month.

After meeting all the expenses, the monthly profits have been calculated which is depicted in the last column of the table. From this column, the mean profit before taxes is found to be Rs. 8,764, which is ranging from Rs.644 to a whopping Rs.52,896 per month. The lowest figure found in this case is pertained to be a profit made from selling dairy products, where the retailers are found to be selling non-dairy products at their disposal. The annual sales-tax figures are found to be misleading and untrue in their cases and hence dropped from being considered further. The minimum and maximum expenses are found to be respectively Rs.617 and Rs.16,758 with a standard deviation of Rs.2,732 per month. The mean expense (Rs.3,779) is distributed among the following heads of expense to assess the major ones.

The major cost heads in this case are wages, house rent and electricity charges which constitute almost 75 percent of the expenses. In total an average amount of Rs.3,779 is expended by a retailer to meet all the expenses out of which wages for the labourers contribute maximum i.e. 37 percent followed by house rent (20 percent) and electricity charges (16 percent).

Table 5.15: Distribution of mean expenses under different heads

Heads of expense	Amount (Rs.)
Wages and salary	1,388 (37.0*)
House rent	772 (20.0)
Electricity charges	612 (16.0*)
Interest and opportunity costs	358 (10.0)
Overheads (maintenance, transportation etc.)	339 (10.0)
Depreciation	310 (7.0)
Total expenses	3,779 (100.0)

*"salary & wages" and wages constitute more than half of the total costs

Here "wages & salaries" and electricity charges are found to be significant at five percent level and depict around 55 percent of the variability in the total expenses. It is also detected that in order to have higher sales it is essential to incur more towards these two major heads (significant at one percent with a correlation of 0.78).

5.3.6 Gross Profit Ratio (GPR)

The gross profit ratio is calculated on the basis of gross profit made from sales upon sales made during a particular period. The higher the ratio, the higher is the profit from the respective sales which generate more revenue for the retailers. The distribution of average sales per day (Rs.) among various products has been depicted with their profits. The idea of GPR here is to detect the preferred and demandable products by the retailers vis-à-vis others.

Table 5.16: Calculating gross profit ratio for various products

Products	Av. sales/ day (Rs.)	Av. sales/ day (percent)	Profit/day (Rs.)	Profit/day (percent)	GPR (profit/sales)
Milk sale (counter)	2,665.00	44	93.00	22	0.03
Milk sale (home del.)	1,459.00	24	117.00	28	0.08
Sweet curd	270.00	4	46.00	11	0.17
WMC	361.00	6	56.00	13	0.16
Paneer	629.00	10	12.00	3	0.02
Chhenapoda	99.00	2	14.00	3	0.14
Kheera	118.00	2	20.00	5	0.17
BMS	184.00	3	37.00	9	0.20
Flavoured milk	121.00	2	13.00	3	0.11
Ghee	169.00	3	10.00	3	0.06
Total	6,075.00	100	418.00	100	-

The table 5.16 portrays the average sales (Rs.) and their respective profits. It is seen that, respectively 44 percent and 24 percent of the total sales are received from counter milk sale and milk sale through home delivery. So milk sale constitutes almost tow third of the total sales made per day which is the major source of earning for the retail outlets. Paneer and sweet curd respectively constitute 10 percent and 6 percent of the sales made per day. Other products though don't have a substantial sale; still add to the sale in varying degrees. Though a counter milk sale has a greater value than sales through home delivery; still higher profit is earned in case of home delivery in contrast to the former. This is followed by WMC, sweet curd and BMS - wherein BMS sells seasonally but earns highest revenue as is seen from the "gross profit ratio" of 0.20. The sales of milk irrespective of its mode (counter/home delivery) constitute more than two third of the sales but generate a combined gross profit ratio of only 0.11 preceded by paneer and ghee. Other dairy products which have got higher gross profit ratios found to have lesser demands and hence not much ordered by the retailers.

5.3.7 Profit vs. investment

There is low degree of correlation found between investments and profit (value of 0.24) which indicates a higher profit margin irrespective of the quantum of initial investments. Though the correlation is found significant ($p = 0.00 < 0.05$), still the lower value of the said indicates an independent relationship between the variables. This is also detected that, there is a high degree of curiosity among the public/shop owners of other kind to take the agency of the brand. To further clarify the fact, the paired sample t-test has been used by considering the pair "investment vs. profit" with an interface of sales during a particular period (hypothesis is mentioned at the end of retail outlet segment). The details of the test are mentioned in the table 5.17:

Table 5.17: Paired sample t-test for investment vs. profit

Pair (2-tailed)	Mean	Std. deviation	Std. error mean	Confidence interval		t statistic	df	Sig.	Result of hypothesis
				Lower	Upper				
Investment vs. net profit	35,069.99	34,728.68	2,835.58	29,466.84	40,673.15	12.37	149	0.00	Accepted

The result in the table 5.17 depicts the t-statistic of the two variables viz. investment and the net profit after the sales made in the retail outlet. This is to measure the impact of sales on the investment made initially, where profit is the outcome of the sales. From the confidence interval and significance value columns, it is clear that the hypothesis is accepted. More precisely it can be said that the hypothesis made earlier is true, in the sense that – retailing of dairy products is a low investing and high profit making business concern. The retailers are found to be making good money out of the business except a few, who retail the products with an intention of expanding their parent business (7.3 percent) and can't concentrate on the later.

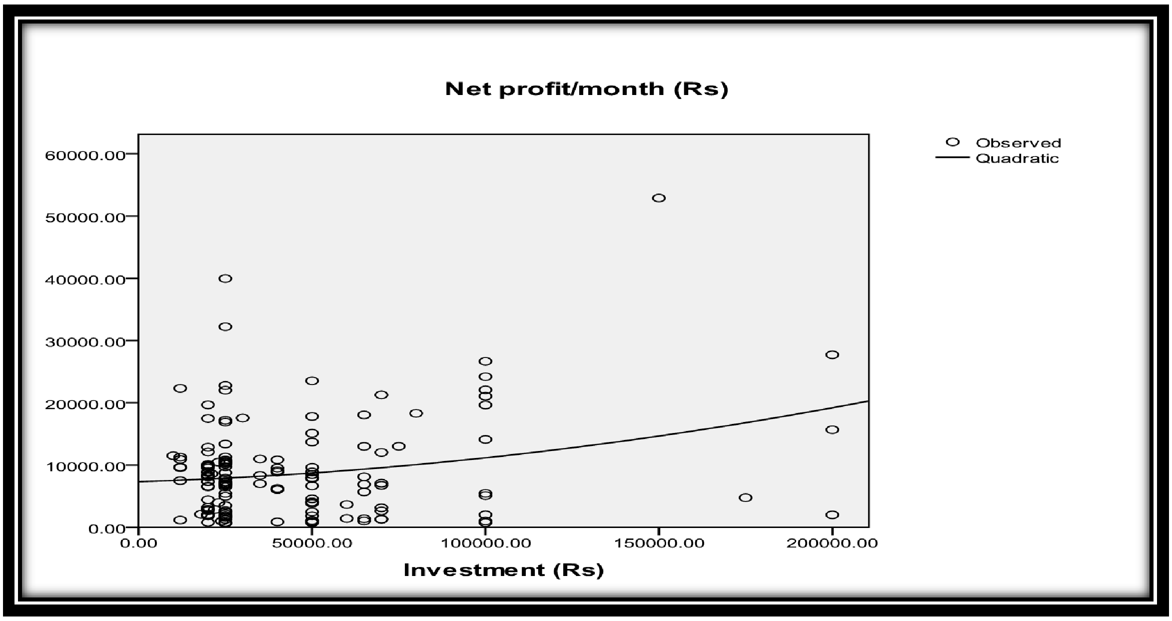


Figure 5.2: Retail investment vs. net profit

The "quadratic curve" appears to be parallel to the axis of investment as plotted against the dependent variable (net profit) explains the lower degree of correlation (0.24) between them further (figure 5.2). Without the loss of generality, it can be said that, the concerned business is a profitable one and hence there is greater demand seen among the prospective retailers to get the authorisation for selling the brand.

5.3.8 Customers' demand fulfilment

Table 5.18: Fill rates of retailers

Statistics	PFR (percent)	OFR (percent)
Mean	77	71
Minimum	30	20
Maximum	95	95

Product fill rate (PFR) is defined as the demand fulfilled out of inventory from a particular store or outlet and order fill rate (OFR) pertains to the fulfilment of demand in an order. Since an order is a collection of several products, in order to have a higher OFR, it is essential to have sufficiently larger PFRs of respective products. Both the fill rates measure the efficiency of the retailers to fulfil the market demand. In some case it is seen that though, there is a potential of the market to consume more products still fear of perishability, won't allow the retailers to order more and the opportunities are found to be foregone.

Product and order fill rates have been described in the above table – which says, the respective means are 77 percent and 71 percent. The minimum and maximum PFRs are respectively found to be 30 percent and 95 percent. In contrast to this, minimum and maximum OFRs are found to be 20 percent and 90 percent. Especially for packaged milk, the PFR of 77 percent indicates that, 23 percent of the market is lost because of lack of product availability. It's seen in the market that, due to lack of availability of dairy products like ghee, the PFR is found to be drastically low which in turn lowers down the overall OFR of the retailers.

There is no significant correlation found between PFR and demographic profile of the retailers. In the same fashion, there is also no significant correlation found between the PFR and the retail operations (distance from the plant and operational area) though, distance and the operational area of the retailers found negatively influencing the PFR (correlation of -0.21 at five percent level). Among all the retailers, the PFRs and OFRs found to vary significantly with 95 percent level of confidence level where the respective Chi-square values are 113.8 and 125.2. The higher fluctuation in this case is attributed to the location of the retail outlet which affects the sales positively and hence impacts the fill rates.

5.3.9 Hypotheses at retailer level

(i) Retailing of dairy products is a low investing and high profit making business concern: It is already verified that $p = 0.00$ (< 0.05) from the earlier discussion and hence the hypothesis is presumed to be true. The plot between the profit and the investment (curve estimation) behaves like a parallel line indicating that there is a profit irrespective of the investment made at the initial stage (table 5.17).

(ii) Higher is the area of operation higher is the sale: In this case since p = 0.11 (> 0.05), the hypothesis is deemed to be rejected. So merely operating in a higher geographical area does not necessarily increase the sales since demand and flair for consuming dairy products in that area plays a vital role. The hypothesis is tested since there is a conflict among the retailers to operate in a higher geographical region anticipating more demand for them. These days (in the urban areas) within the radius of 500 metres from the retail outlet, no other retailers are permitted to sale the brand (table 5.13.1).

5.4 Customers as the End Point of the Supply Chain

Any firm irrespective of its nature of operation can't survive without the existence of the customers. The below are mentioned some analysis of the customers' views on the products and services of the dairy food supply chain.

5.4.1 Purchasing pattern

In order to know customers' purchasing mode with their monthly income, cross tabulation have been carried out. It is seen that as people jump from lower income group to higher income group, they usually prefer to order the packaged milk from their home on monthly basis where, the payment is made to the booth holders at the end of the month. The correlation between the income groups and the mode of purchase (0.31) is found to be significant at one percent level.

Table 5.19: Customers' purchasing pattern of milk vs. monthly income

Pattern of purchase	Monthly income (Rs.)				
	<10,000	10,000-20,000	20,000-30,000	30,000-40,000	>40,000
Counter purchase	68.8	73.0	49.1	27.4	35.3
Home delivery	31.2	27.0	50.9	72.6	64.7
Total	100.0	100.0	100.0	100.0	100.0

*figures in percent

It is clear that as the customers move from a monthly income of Rs.10,000 to Rs.40,000, the significant changes occurs from 27 percent to as high as 72.6 percent (table 5.19). Higher income leads to change in the purchasing pattern. Dairy products at the same time are meant to be sold at the counter only and hence excepting on some celebrations there is no provision to deliver them at the door step of the customers.

5.4.2 Consumption and expenditure on dairy products

Most of the families in the study areas found to be purchasing milk as low as half a litre to as high as four litres of milk every day with a standard deviation of half litre. Since the milk packets are available only in the denomination of half litre so the scope of purchasing is limited to a multiplier of half litre packets. The size of the family is varying from two to nine with a mean of five members.

Table 5.20: Per capita consumption and expenditure on dairy products

Statistics	Milk/day (lt)	Size of family (nos)	Per capita milk/day (gms)	Exp-milk/ month (Rs.)	Exp-dairy pdts/mon (Rs.)	Tot. exp/ month (Rs.)	Exp. as % of income (percent)
Mean	1.00	5	270	600	400	1,000	4.29
Std. devia.	0.50	2	146	300	250	550	1.77
Minimum	0.50	2	56	300	0.00	300	0.24
Maximum	4.00	9	1,000	2,400	1,400	3,800	7.44

It may be noted that, upon a fixed amount of purchase on milk, the higher members of the family lowers down the per capita availability of milk and hence lowering down the consumption too. The per capita milk consumption is found to be 270 gms/day whereas the minimum and maximum are found to be respectively 56 gms and 1,000 gms. The standard deviation in this case is detected to be around 146 gms per day which shows the fluctuations in consumption trend among the sample respondents. The per capita consumption of milk is found to be more than the per capita availability in the country (that is 246 gms/day).

Accordingly the expenditure on the liquid milk is varying in between Rs.300 to Rs.2,400 per month with a mean of Rs.600. The standard deviation is also varying to the tune of Rs.300 (cost of one packet of milk, if purchased from the counter). The cost of milk is Rs.20 if purchased from the counter else Rs.21 per litre if ordered from home (Rs.0.50/pouch extra for home delivery).

The expenditure on the dairy products is varying till Rs.1,400 per month with a mean and standard deviation expenditure of Rs.400 and Rs.250 respectively. Expenditure on milk and dairy products in aggregate is varying from Rs.300 to Rs.3,800 per month with a mean expenditure of Rs.1,000 and a high standard deviation of Rs.550. Though consumption of dairy products is highly dependent on income still, the dairy products like curd or paneer in the regular food menu is found to be missing. The fact is more clarified from the low mean and high standard deviations in case of dairy product expenditure (62 percent variability). To meet the monthly expenses of dairy products, the customers are expending between 0.24 to 7.44 percent of their income. The average income meant for expending on the dairy products is seen to be around four percent with a standard deviation of 1.77 percent.

5.4.3 Expenditure on dairy products vs. demographic profile of customers

The expenditure on milk and allied products is pretty dependent upon the income level of the customers. However there are some other demographic characteristics of the customers which drive them to consume milk and its derivatives due to increase awareness and size of the family. The table 5.20.1 depicts the behaviour of the customers towards the expenditure on dairy products.

Table 5.20.1: Correlation of expenditure on dairy products vs. demographics

Education	1.00					
Occupation	-0.06	1.00				
Monthly income	0.17	0.04	1.00			
Size of the family	0.03	0.13	0.10	1.00		
Expenditure on dairy products	0.18**	-0.05	0.37**	0.11*	1.00	
Expenditure on dairy products (percentage of income)	0.12	-0.08	-0.14*	0.11	0.47	1.00

*significant at five percent and **significant at one percent levels

Education (correlation of 0.18) and size of the family (0.11) are among two major demographic characteristics of the customers which influence the dairy product consumption in the family. The positive correlations (significant at one percent and five percent level respectively) indicate that higher education and larger family sizes lead to higher consumption of dairy products. There is a significant correlation found between income and expenditure on dairy products including milk. But the lower correlation value (0.37) explains that, the rate of change expending on these items is not proportionate to the change in salary. From the below given curve estimation, it can be clearly interpreted that, there is a sharp rise in expenditure when people move from lower income group (less than Rs.10,000) to higher income group (Rs.20,000 to Rs.30,000). The slope of the curve is higher at the origin comparing to the slopes at the subsequent part of it, indicating that the highest change occurs at the first two income groups, which necessarily influence the expenditure on the dairy products.

At subsequent part of the curve, it is as good as a straight line indicating that, the change is not substantial with respect to change in salary. The curve estimation also shows that only 15 percent of the change in dairying expenditure could be attributed to the income hike (significant at 5 percent).

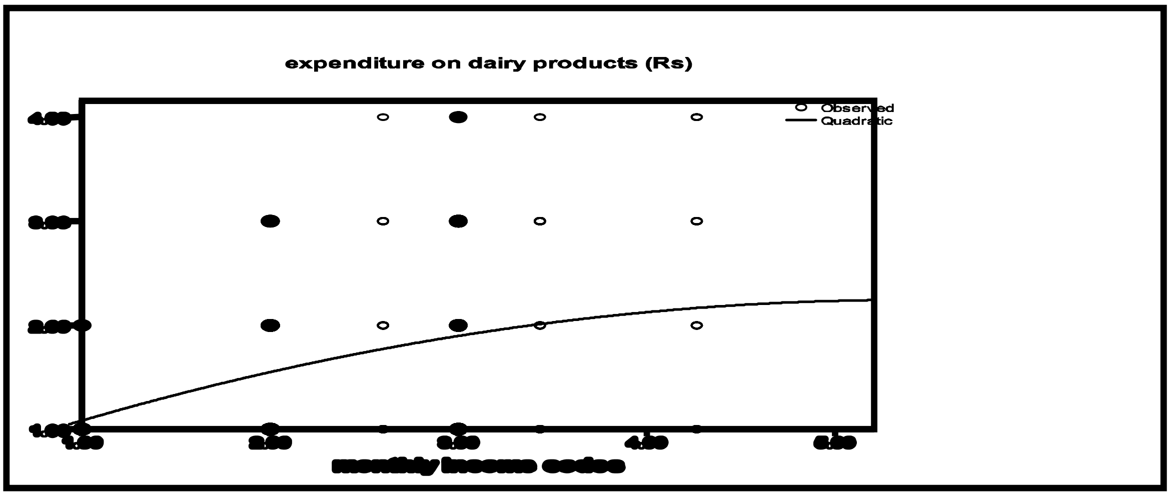


Figure 5.3: Income vs. expenditure on dairy products

Another correlation is also retrieved in the table which says, “higher is the income lower percentage of it is expended towards the dairy expenditure (correlation of -0.14 with five percent level of significance).”

5.4.4 Drivers of purchasing the brand

It may be noted here that the variables mentioned in the table are significant at five percent level (chi-square test at four degrees of freedom) and hence treated to be the influencing factors for the brand purchase.

Table 5.21: Driving forces of brand purchase (figures in percent)

Dimensions	First Priority	Second Priority	Third Priority	Fourth Priority	Fifth Priority	Total
Retailer accessibility	6.2	9.6	20.7	41.0	22.5	100.0
Product availability	8.6	20.4	24.4	22.2	24.4	100.0
Product quality	33.3	22.2	35.2	3.4	5.9	100.0
Product safety	26.9	43.2	16.4	6.8	6.8	100.0
Reasonable price	8.3	4.9	14.8	46.3	25.6	100.0

There are basically five dimensions of making a purchase of the brand found in the research areas. It says that retailer availability, product availability, quality, safety and price to some extent are the driving forces in this case. Comparing to the figures mentioned in the above table, it can be inferred that quality and safety are the major drivers in purchasing a perishable product like milk and dairy products.

The quality and safety dimensions have been opined by every one third of the respondents as their first priority whereas the same are within the first three dimensions unlike any other dimensions mentioned. More than half of the respondents make a purchase since it is available and it is within their third priority. All other dimensions though not much important to make a purchase still found significant. For an instance, people with weak financial background will definitely look for price affordability as well as retailer approachability. For them it is difficult to order the product from home and hence purchase the product (packaged milk) from the nearby retail outlet.

5.4.5 Perception towards price rise

Due to high inflation these days the prices of products and services are increasing at an alarming rate. For certain products it becomes a concern while for other products it is not an issue at all. For some products like milk (the need for the lower income group and demand for the higher income group), the inflation is hardly a concern since it is mostly purchased by people with some standard level of income (around Rs.10,000 per month). In order to know the perception of the customers towards the price rise (though it is not in agenda of the federation) the following figure is generated. While some of the customers are indifferent to the issue some switch over to other brands if available in the market with a lower price.

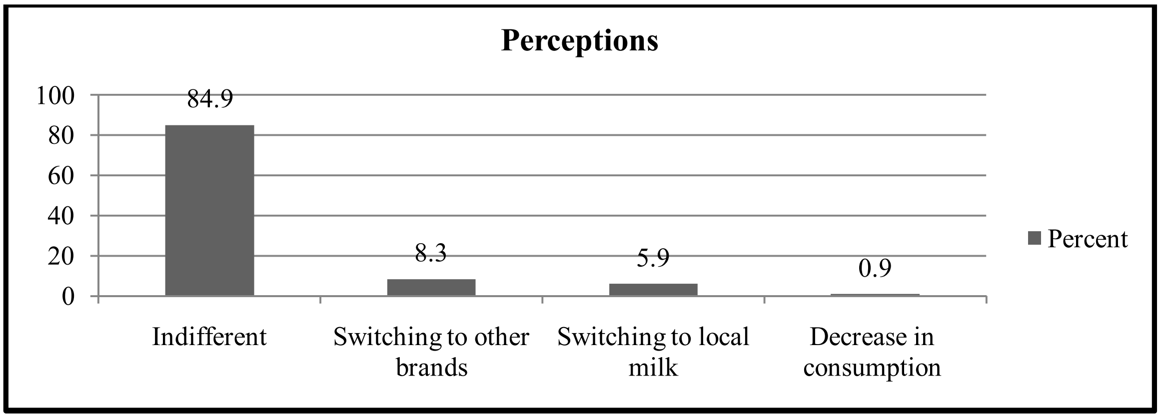


Figure 5.4: Customers' perception towards price rise

The above table says the perceptions of the customers regarding price rise of the dairy products. Many a times due to inflation and the resource constraints, the companies are compelled to increase the prices of various products and in case of the dairy companies it is also no deviation. In this the opinions of the customers have been taken to investigate their reactions to the price rise of dairy products of the brand. It is found that around 85 percent of the customers remain silent over the issue conveying that they do not have any reaction to the issue. Customers' perceptions in this connection are very clear saying:

> "If the price of a water bottle is Rs.15/ litre, there is nothing to be worried if the prices of the dairy product increase. The common man has added the dairy products in his/her regular food items."

To support the argument a report of National Council of Applied Economic Research (NCAER) is cited here. As per the report (2010) the high income households exceed low income families in the country. To be more precise the report on, "How India Earns, Spends and Saves", says there are 46.7 million high income households (income of more than Rs.180,000/annum) comparing to 41 million low income households (income of less than Rs.45,000/annum) in the country. The intermediate income is indicating the middle income households and there are 140.7 million households of its kind by 2009-10.

The income groups have been taken as per 2001-02 prices. The report which based on the "National Survey of Household Income" with a sample size of 63,016, mentions various parameters where the households generally expend their money. India, these days, is one of the emerging economies in the world and so are its people. So affordability for products like "milk" is not at all a concern for the customers. This shows the inelastic behaviour of the product sales with respect to its market price. The cross tabulation table is not generated here since the above instance is enough to justify the claim.

5.4.6 Measuring customer satisfaction

In order to measure the level of customer satisfaction, there are three basic indicators chosen namely; product, retailer and company as a whole. Individually the performances of each of the items have been measured and finally all of these measures proportionately considered finding out the overall performance of the brand. The values are indicating the level of customer satisfaction for the respective indicators as well as the items' performances. The higher is the performance of the items, it can be concluded that the higher will be the customer satisfaction on the brand as a whole.

Table 5.22: Opinions of customer on various brand parameters (figures in percent)

Indicators	Sub-indicators	Very low	Low	Neither high nor low	High	Very high
Product	Availability	1.2	12.0	34.9	33.3	18.5
	Appearance	4.9	8.3	27.2	43.8	15.7
	Taste	2.2	10.8	35.5	32.4	19.1
	Freshness	4.3	14.2	34.0	34.0	13.6
	Safety	3.4	11.4	29.0	34.6	21.6
	Reliability	2.2	10.8	27.8	38.0	21.3
	Certification	0.9	5.9	28.4	37.3	27.5
Retailer	Accessibility	3.9	13.1	35.6	33.7	13.7
	Home delivery	6.2	19.8	24.5	28.8	20.7
	Timely delivery	15.3	25.8	24.8	18.2	15.9
	Prioritising loyal customers	10.3	24.4	30.2	21.5	13.5
	Consistency in service	11.4	19.9	36.3	20.5	12.0
	Mutual trust	9.0	22.7	34.9	23.4	10.0
	Information sharing	12.1	24.5	34.1	19.5	9.9
	Communication	10.6	23.4	30.6	25.9	9.4
Federation	Understanding of customer needs	12.5	29.4	31.3	18.4	8.4
	Responsiveness towards complaints	17.9	24.4	38.3	14.8	4.6
	Customer centric vision	21.3	33.8	32.2	8.8	4.1
Overall performance of the brand		0.0	13.3	68.2	18.5	0.0

(i) Performance of the products: There are seven items considered for measuring the product performance. It can be seen from the table 5.22 that, almost half of the customers are somewhat satisfied with the performance of the products whereas more than one fourth of them are at the middle not conveying any message. Less than one fourth of them are on the negative side of the opinion curve.

(ii) Performance of the retailers: Excepting home delivery and accessibility, retailers' performance in all other parameters are not so satisfactory, where the retailers need to be little more stretched. The customers, who purchase milk from home on monthly basis are not satisfied with the timely delivery of the milk and is opined negatively by more than one third of them.

(iii) Performance of the company: In case of the company, more than one third have opined negatively whereas less than one third of the customers are somewhat satisfied with its performance. The higher discontentment percentage could be due to product quality deterioration and disproportionate worth of the product with respect to the price.

5.4.7 Identification of factors for customer satisfaction (Factor Analysis)

It is found that, almost one third of the respondents are at the neutral position and one third of them each at both sides of the opinion curve, no proper inference is drawn and hence the factor analysis of the sub-indicators have been carried out to detect the major indicators which lead to customer satisfaction. It is seen from the preliminary statistics of factor analysis that, the "determinant of the correlation matrix = 0.04 > 0.00001, Kaiser Meyer Olkin Measure = 0.5 < 0.69 <1 and Bartlett's Test of Sphericity is verified. Hence the factor analysis can be applied here without to reach at the major factors for customer satisfaction.

Table 5.22A: Rotated component matrix of various items of customer satisfaction

Factors of customer satisfaction	1	2	3	4	5	6	7
Retailer-mutual trust	0.79						
Retailer-information sharing	0.77						
Retailer-consistency in service	0.66						
Retailer-communication	0.64						
Retailer-timely delivery		0.73					
Retailer-prioritizing loyal customers		0.70					
Product-availability		0.69					
Product-reliability			0.75				
Product-safety			0.72				
product freshness			0.64				
Company-responsiveness towards complaints				0.77			
Company-customer centric vision				0.76			
Company-understanding customer needs				0.63			
Product-appearance					0.79		
Product-price					0.76		
Product-taste						0.84	
Product-certification							0.75
Retailer-accessibility							0.64

The first, second and third factors respectively have 17, 10 and 9 percent variances. Other four factors contribute to one fourth of the variability in the overall customer satisfaction. Clearly these seven factors contribute to 61 percent of variability in the customer satisfaction index. The variables with less than 0.60 correlation-values have been dropped in order to bring out the highly influencing factors for further analysis. There are seven shaded regions with eighteen different factors.

These seven regions will be considered as seven factors with a suitable title combining the respective sub-indicators associated with them. They are named as follows:

(i) Packaging and labelling of the products;

(ii) Safety and reliability of the products;

(iii) Taste of the products;

(iv) Accessibility of retailers;

(v) Responsiveness of the retailers;

(vi) Reliability of retailers and

(vii) Customer centric vision of the company.

5.4.8 Customer satisfaction index

In continuation to the factor analysis the mean scores of each of these factors with respect to their variability in the "overall satisfaction" of the brand have been mentioned in the table below.

Table 5.23: Quantifying customer satisfaction

Factors	Variance	Weightage	Mean score	Total score
Packaging and labelling	0.06	0.10	0.77	0.08
Safety and reliability	0.09	0.15	0.70	0.10
Taste of the products	0.06	0.10	0.84	0.08
Accessibility of retailers	0.05	0.09	0.70	0.06
Responsiveness of retailers	0.17	0.28	0.71	0.20
Reliability of retailers	0.10	0.17	0.70	0.12
Customer centric vision	0.07	0.12	0.72	0.08
Score	0.61	1.00	-	0.73

It is found from the table 5.23 that, 73 percent of the customers are satisfied on the performance of the brand. On the contrary, performance level of the aforesaid factors is 73 percent in the market place. So there is a further scope for the brand to improve in order to enhance the level of customer satisfaction. The most important areas in order of priority are – accessibility of retailers, packaging and labelling of the product, taste of the product and vision of the company to meet customer expectations.

Retail base is not enough to meet the customer demand especially for the customers who prefer to purchase packaged milk from the retail counters. While discussing the packaging and labelling of the product (in guised manner), it is also said to address the incompatibility price issues. Product taste is found to be deteriorating day by day, as opined by the regular customers of the brand, should not be taken in a lighter way to preserve the market share. Company's customer centric attitude is found to be lacking, especially in relation to the quality of the products which might result in losing market share and leading to customer dissatisfaction.

5.4.9 Hypotheses at customer level

(i) There is a high degree of positive correlation between income and expenditure on dairy products: In response to the hypothesis made, it is seen that there is a positive correlation (0.37) between monthly income and expenditure on dairy products at one percent level of significance. It is also seen that as people move from lower income group to higher income group the change takes place but in the higher income groups the change is not significant. It is inferred that the higher is the level of income higher is the expenditure on the dairy products is not always true and hence the statement is partially correct (table 5.20.1 and figure 5.3).

(ii) Customers are increasingly becoming quality conscious while making a purchase: Quality of the product is opined by 91 percent of the respondents - which falls within first to third priority in the top five priorities of making a purchase of the brand ($p = 0.00 < 0.05$).

5.5 Conclusion

Comparing to the procurement part of the supply chain, production and distribution part of the supply chain functioning better which is a good indication. But in keeping view to the seasonal fluctuations in milk production the procurement gets seriously affected which ultimately obstructs the productions in the plant affecting the distributions seriously. Moreover the quality of the product and matching of quality with respect to the price are two other aspects which should be taken care of by the plant.

5.6 References

Chauhan, A. K., Dhaka, J. P., Singh, S., Chandel, B. S., & Sharma, S. P. (2006). Economic analysis of milk processing in organised and unorganised sectors of Haryana. *Indian Journal of Agricultural Marketing, 20*(3), 84-96.

Elumalai, K., & Sharma, R. K. (2008). Trade protection of India's milk products: Structure and policy implication. *Indian Journal of Agricultural Economics, 63*(1), 67-83.

National Council of Applied Economic Research. (2010). *How India Earns, Spends and Saves*? New Delhi: Author.

Tiersten, S. (1989). The changing face of purchasing. *Electronic Business*, 22-27.

CHAPTER VI

IDENTIFICATION OF RISKS AND THEIR IMPACT ON SUPPLY CHAIN

Risk identification and assessment have been presumed to be some of the major issues in supply chain management. The risks and uncertainties obstruct the flow of the supply chain and decrease the performance above all. In order to eliminate or minimise the impact of the risks and uncertainties on the supply chain, it is highly imperative to identify them and take action. In this chapter the supply chain risks and uncertainties are identified, categorised on the basis of their impact on the supply chain from a dairy industry perspective. The impact of significant risks and uncertainties on the supply chain are also discussed elaborately.

6.1 Ensuring Existence of Supply Chain Risks

In order to get confirmed whether risks and uncertainties exist for the supply chain, the following discussion is made and inferred accordingly. The responses are based on the researcher's observation of stakeholder's perception towards risks and uncertainties.

Table 6.1: Ensuring existence of supply chain risks

Issues pertaining to supply chain risks	Response	Response (numeric)
Knowledge about the critical suppliers and impact of their failure on the company's profit	Yes	1
Mapping of supply chain both upstream and downstream	Yes	1
Integration of risk management into supply chain approaches	No	0
Routine and timely systems for measuring financial stability of critical suppliers	No	0
Understanding of tier 1 production facilities and logistic hub exposure to natural catastrophes	Yes	1
Integration of supply chain risk management into enterprise risk management approach	No	0
Recording of supply chain incidents and actions taken to avoid future incidents	No	0
Tier 1 suppliers have business continuity plans that have been tested in terms of their validity	Yes	1
Provision for risk training to the supply chain team	No	0
Putting risk on agenda at the performance meetings with strategic suppliers	Yes	1
Score	-	5

Source: www.supplychainriskinsights.com

The table depicted above has 10 items pertaining to supply chain risks with response codes as "0" and "1". While "1" indicates "yes" to a query, "0" indicates "no". The score of "5 to 7" (medium score) confirms a number of key gaps in the process affecting the brand or profitability of the supply chain. A score of "8 to 10" indicates a good understanding and control of risks in the supply chain. In this case, the score is retrieved as "5" and indicates that there are lot of flaws in the supply chain which affect its profit and brand value negatively. The following discussion is made on the risk likelihood and the severity with respect to their scaling.

6.1.1 Risks: probability and severity

As discussed earlier in the literature, the risk is a factor influencing the supply chain negatively with a known frequency or likelihood. The probabilities or likelihoods have been considered by consulting with the dairy experts and researchers. For each risk - probability, severity and impact separately make it to 100 percent of the responses. It can be noted that, the people at the middle of the scale are indifferent to a particular risk (impact) and do not really play a major role in the analysis. People at either side of the "middle value" play a vital role in the analysis depicting whether a particular risk is to be carried forward or dropped. If the number of responses at the either side of the "middle value" differs significantly, they are being taken for further analysis. Furthermore, a risk is really a matter of worry if its impact on the supply chain is high (both probability and severity are higher). The impact is lower, if either of the two variables have lower values and hence the inherent risk does not have much impact on the supply chain.

Initially at each level, the risk opinions are generated and based on their weightages they have been carried forward to be used in multiple regressions to see the model fit. Finally from t-test values the risks have been categorised as high, medium and low upon being proved that they are significant ones at five percent level or so.

6.2 Description of Risks at Various Level of Supply Chain

From dairy food supply chain it is evident that there are seven key stakeholders namely milk producer, cooperative society, bulk milk coolers, production plant, transporting agencies, retail outlets and customers. At each level the risks and uncertainties are discussed from a view point of developing countries' organised dairy food supply chain with a special reference to the Indian dairy industry.

6.2.1 Risks at the milk producer level

Milk producers (suppliers of raw milk) are mostly illiterates and landless. Illiterate milk producers do not have much access to the intricacies of business practices creating great difficulty for themselves as well as for the upstream members of the chain. Since a large number of them possess land marginally, it is almost difficult for them to cultivate green fodder for their cattle.

In the absence of or virtually less, green pastures for cattle, it is imperative for them to buy dry fodder available in the market which is undoubtedly a costlier affair. This complexity is further multiplied when they get it extremely difficult to market their produce. This ultimately compels the poor milk producers to opt for the dairy cooperative societies who pay non-remunerative price for the same. The whole Indian dairy industry depends on these milk producers who stay in the villages and semi-urban areas.

It has been seen that, the milching capacity of Indian cow is only 987 kg per annum as against world average of 2038 kgs. This low milching capacity not only brings down their income rather becomes responsible for the low procurement of milk for the entire supply chain. Seasonal fluctuations in production add difficulty to the low production of milk further. It may be noted here that, from the month March to August, the milk production capacity of the cows decreases and brings down the earnings of the milk producers.

Today, it is noticed that some of the dairy federations have pressed a 'penalty system' for the low milk solid content in the milk. If the total milk solids (TMS) are less than 12.5 percent then the milk price is undervalued with due deductions. Though intention of the federations/farms here is to bring up quality in milk production process still, it puts a pressure on the milk producers. In order to get quality milk from cows, it is extremely important for the milk producers to feed them properly due to higher fodder cost and decreasing size of the green pastures.

Now-a-days high cost of feed and fodder has emerged as one of the biggest problems worldwide and is responsible for the increase in cost of milk production and quality deterioration. In the light of the milk producers difficulties as risks and uncertainties the opinions of the milk producers are generated from the field survey and are being depicted in the table.

Table 6.2: Milk producers' opinions on various risks (figures are in percent)

Risks	Probability					Severity					Impact				
	Very low	Low	Neutral	High	Very high	Insignificant	Minor	Neutral	Serious	Catastrophic	Very low	Low	Neutral	High	Very high
Lack of coop. & info. sharing	16	23	27	20	15	1	2	23	41	33	17	26	30	21	6
High cost of feed fodder	1	4	16	41	37	1	3	14	29	53	3	6	24	42	25
Illiteracy and ignorance	4	19	28	25	24	1	6	23	37	33	5	31	22	29	13
Perishability of milk	43	28	12	8	10	6	12	27	31	24	50	32	5	7	6
Non-remunerative price	5	11	12	29	43	3	4	15	26	51	9	11	21	33	27
Seasonal fluctuations	3	5	20	30	43	3	4	14	28	52	6	9	27	33	26
Mortality rate of cattle	44	37	9	5	5	3	10	35	20	33	49	37	8	3	2
Imposed penalty	28	33	16	14	9	10	17	33	22	18	37	35	15	9	3
Low-milching cattle	12	18	20	22	28	1	5	22	30	41	15	22	23	23	17

It is seen from the table 6.2 that, in some of the risks, opinions are fluctuating for probability and severity and hence lowering down the opinions for the variable "impact". For an instance, in case of "lack of cooperation and information sharing", 35 percent of the opinions are raised for the likelihood of the event, whereas 74 percent of opinions refer to the severity bringing down the opinions in favour of impact (a mere 27 percent) ultimately decreases the mean value of the same while increasing the standard deviation. This particular kind of situation brings up inconsistency in the opinion poll and gives rise to misleading or sub-optimal information. Since a kind of rough idea is made from this opinion table, hence there is no rationality to further furnish the coefficient of variation table in order to avoid exaggeration.

The people, who are at the left hand side of the "middle value" opine against the statement indicating that, a particular risk head is not a matter of worry and hence won't help much to identify the risks and uncertainties for the supply chain. The similar kind of argument can also be made for the variables, "perishability", "mortality rate of cattle" and "imposed penalty due to low TMS". Except these variables the rest of the variables are being considered further to reach at a conclusion.

6.2.2 Risks at the dairy cooperative society level

Milk producers in the rural areas are organised into the dairy cooperative societies. These societies collect milk form the milk producers on behalf of the milk unions or federation.

In most of the cases it is found these don't have proper infrastructure, adequate milk testing equipments and chemicals used for measuring the fat content of the milk. Sometimes the milk procured from the producers is stale which ultimately damages the whole milk collected rendering a heavy loss to the unions. Low price for the milk brings down the involvement of milk producers at their disposal. This ultimately brings down the milk procurement at the society level.

The transportation of milk from society to the chilling centre is also a matter of worry because there is no formal mode of transportation. It has been seen that cycles and trolleys are being used for this shifting; putting the flow of the material at stake. Further these societies are mostly debt ridden and facing financial crunch in their day to day business.

Penalty system pressure what is being discussed above is applicable to these societies too. The policy makers (unions/federation) hardly confront the milk producers in the villages unlike the supervisors of the unions and secretaries of the DCSs do. The secretaries of the DCSs disburse money to the milk producers, who in turn fall prey to the curse of the poor milk producers because of price reduction for low TMS. Gradually they find it difficult to organise the milk producers in the society any more in the long run and get the DCSs defunct eventually.

Table 6.3: Society secretaries' opinions on various risks (figures are in percent)

Risks	Probability					Severity					Impact				
	Very low	Low	Neutral	High	Very high	Insignificant	Minor	Neutral	Serious	Catastrophic	Very low	Low	Neutral	High	Very high
Financial risks	8	24	31	15	22	1	5	22	43	29	11	29	35	16	9
Low procurement	3	14	22	31	30	2	5	24	28	41	4	23	28	28	17
Illiteracy and ignorance	6	10	33	27	24	4	13	24	32	27	10	26	28	28	8
Non-remunerative price	6	17	12	26	39	1	4	20	22	53	6	24	17	29	24
Low profit margin	16	24	23	21	16	5	14	34	21	26	22	33	23	14	8
Delivery risk	34	33	18	7	8	6	22	34	26	12	43	34	16	4	3
Lack of coop. & info. sharing	22	42	16	12	8	8	15	39	22	16	31	45	13	8	3
Process/control/quality risks	4	20	21	38	17	1	8	25	27	39	8	28	23	35	6
Intense competition	44	26	13	10	7	6	19	36	23	16	50	25	12	8	5
Lack in leaderships	3	12	33	31	21	3	12	26	34	25	6	30	28	30	6

It is seen that financial risks, less profit margin, delivery risk, lack of cooperation & information sharing and intense competition don't have substantial opinions comparing to rest of the variables. For an instance, "financial risks" have been opined positively by only 40 percent of the respondents as a "low" risk while around one third of them have found to be opined it as "neither low nor high" kind of risk. A mere 25 percent of them are found to have opined it as one of the high risk factors. Since a larger percent of them opine against the statement, hence it does not seem to be a real worry for the DCS. The result which is being discussed from the "impact" column brings out the real problems in their case.

The conclusion regarding the opinions also can be drawn from the "probability" and "severity" columns. From the probability column of "financial risk", it can be seen that, respectively eight percent and 24 percent of the respondents opine it as "very low probable" and "low probable" risk whereas around one third of them are at the middle of the scale indicating the risk to be "neither high nor low probable" risk. Furthermore 15 percent of them respond it to be a "high probable" risk and the rest 22 percent depict it to be a "very high probable" risk. It is seen clearly that, a higher proportion of them (37 percent) are at the positive side of the scale whereas slightly a lesser proportion (32 percent) are at the negative side of the scale. Around one third, which is at the middle of the scale do not add much to the inference of the table.

A similar kind of interpretation can be made for the "severity column" too. It says, while only six percent of the respondents take the risk as "not a severe" one while, 22 percent have found to be indifferent on the issue. As high as 72 percent of them opine that the risk is a severe one while 37 percent only opine for the probability. This higher mismatch between probability and severity brings down the score in the impact column and hence gives rise to higher inconsistency. All other kinds of risks mentioned above are also relate to this judgement and hence lead to higher inconsistency to be debarred from further analysis. On the other side of the interpretation, the event like "low procurement" has got reverse results comparing to "financial risks".

This interpretation from the impact column says that, 45 percent of the respondents have opined in favour of the statement whereas only 27 percent are found to be against it. The rest of them are at the middle of the scale. Since a greater proportion of them speak the event to be a problematic one, hence the statement has been carried forward to be analysed further. To be more specific about the issue, probability and severity of it can be assessed further. These reveal that, a higher proportion of the respondents are found to be on the opinion of "higher side" comparing to the "lower side" of the scale.

6.2.3 Risks at the bulk milk cooler level

Milk unions at the district headquarters collect milk from the dairy cooperative societies through the bulk milk coolers or the chilling centres. The procured milk is chilled in order to curb perishability and stored till it is being collected by the transporter. The bulk milk coolers are mostly funded by the govt. of India, district rural development agencies (DRDA) and other agencies under various schemes. In this case, usually the land is provided by the state federations and the infrastructure is taken care of by the funding agencies. Irrespective of this they do not perform well in the field.

The biggest difficulty in this case is the low level of milk procurement from the DCSs which are geographically scattered and no well to do business entities. This makes them operate at lower level of their capacity which in turn increases the chilling cost of the milk. These chilling centres or the BMCs are being operated by under-qualified persons. It is because of the low payment, deserving persons won't prefer this kind of jobs. In many places it is also found that skilled/qualified persons are not available irrespective of higher salary.

Table 6.4: BMC Plants-in-charge's opinions on various risks (figures are in percent)

Risks	Probability					Severity					Impact				
	Very low	Low	Neutral	High	Very high	Insignificant	Minor	Neutral	Serious	Catastrophic	Very low	Low	Neutral	High	Very high
Lack of skilled workforce	9	21	34	21	15	0	9	30	43	18	15	24	31	27	3
Volatility in fuel prices	12	18	30	30	10	6	3	45	19	27	10	18	40	24	8
Financial risks	0	27	37	27	9	18	6	52	21	3	0	39	46	6	9
Perishability	0	33	46	15	6	12	18	42	22	6	0	36	46	15	3
Process/control/quality risks	15	9	10	30	36	3	18	18	40	21	18	15	10	42	15
Seas. fluctuations	0	4	30	48	18	0	6	24	22	48	3	6	40	33	18
Delivery risks	0	9	28	36	27	3	0	15	52	30	3	9	33	27	28
Lack of coop. & info. sharing	30	6	48	12	4	0	9	24	64	3	33	6	46	12	3
Low procurement	0	0	36	30	34	0	0	0	58	42	0	0	36	30	34
Imposed penalty	18	27	22	21	12	0	15	40	33	12	27	24	21	18	10
Hazard risks	0	36	25	30	9	18	12	22	30	18	15	31	30	18	6

The chilling centres sometimes keep the chilled milk with them for four to five days because of the transportation problems which automatically raises the cost of chilling, decreases the profit margin and food value of the milk. Introduction of the penalty system rather makes the situation more complicated and disbursement of money to the DCSs becomes a hectic task for the plants-in-charge of the BMCs leading to dissatisfaction at each level in the procurement side of the supply chain. Sometimes it has been experienced that there is a variation of TMS level according to the reports of the BMCs and production plant creating a conflicting situation for them.

Here there are 11 risk factors have been considered which are depicted in the table 6.4. From the impact column it can be seen that fuel (energy) price volatility, poor quality, seasonal fluctuations in collection, delivery risks and low procurement are opined by higher proportion of the respondents than the proportion of respondents who refute it. For instance, fuel price volatility has been responded by 32 percent of the respondents as “high risk” whereas 28 percent of them have categorised it as “low risk”. Even though the majority (40 percent) of them put it on “neither high nor low” category; still looking into the higher proportion of the opinions on the right hand side of the scale, the risk head have been due weightage for further consideration.

The probability and the severity of the event also fingers out towards the right side of the scale (through value “3”) which can be seen from the table itself. Since the higher opinions are obtained in the right hand side of the scale, the impact column also gets the same. The higher is the fluctuation in the probability and severity, the higher is the fluctuation reflected in the impact column, which sometimes brings down the opinions in certain cases. Excepting to this risk head all other risks mentioned earlier also show similar kind of opinions and have been carried forward to reach at a conclusion.

6.2.4 Risks at the production plant level

Milk and its derivatives are highly susceptible to perishability and require conditioned transportation and storage. In order to curb this impasse the production plants operate in a certain geographical region to facilitate distribution. Since the transportation of these items need air conditioned or insulated vehicles, it is not always possible for the plants to expand their operational area. Forecasting is another crucial concern for these plants since they do not have a formal forecasting mechanism.

The processing plants lack in infrastructural facilities. Outdated technologies, processes and shortage of skilled man power, steep competition and increased cost of production etc. retard the production and operation of the plant. Moreover inadequate transport facility, damage and leakage during transportation and delivering the product to the scattered and small retail outlets are some of the other major problem areas which the plants experience in their day-to-day business affair. Directly or indirectly the risks and the uncertainties at other levels of the supply chain also hamper the growth of the production plants.

Opinions of the respondents at the production plant are not mentioned in the form of frequency table due to their fewer responses and hence the mean score of the values have been considered with the standard deviation for each risk head. Finally the coefficient of variation (C.V) has been considered to curb inconsistency in the opinions and the risk heads with a comparatively low C.Vs have been carried forward to find the significant risks.

Table 6.5: Risk scores at the production plant level (figures are in scale values)

Risk heads	Probability	Severity	Impact	Std. dev	CV
Low milk procurement	2.95	3.40	2.40	0.88	37.00
Inefficiency in managing inventory	4.05	4.20	3.70	0.98	26.00
Communication distortions	2.30	3.45	2.10	1.25	60.00
Seasonal fluctuations in procurement	3.70	4.30	3.60	1.14	32.00
Capacity constraints	3.10	3.60	2.75	1.12	41.00
Demand unpredictability	3.60	4.15	3.45	1.23	36.00
Process/control/quality risks	3.60	4.30	3.50	1.05	30.00
Lack of cooperation and info. sharing	3.75	3.90	3.40	1.14	34.00
Increasing variety of production	3.45	3.85	3.10	0.97	31.00
Logistical risks	3.90	4.30	3.70	1.08	29.00
Hazard risks (fire, sabotage etc.)	4.05	4.50	4.05	0.83	20.00
Perishability	3.30	3.95	3.00	1.08	36.00
Intellectual property risks	3.80	4.05	3.55	1.00	28.00
Supplier unreliability	3.50	4.20	3.40	1.35	40.00
Volatility in energy/fuel prices	3.95	3.95	3.65	0.75	20.00
Damage and spillage during transit	3.40	3.75	3.15	1.14	36.00
Financial risks and hardships	3.20	2.85	2.25	0.97	43.00

It can be seen from the table 6.5 that, "inefficiency in managing inventory, process/control/quality risks, logistical risks, hazard risks, intellectual property risks and volatility in energy/fuel prices" have got comparatively lower C.Vs and hence more consistent opinions presumed in these cases. All other risks are not being considered henceforth keeping view to the higher inconsistency level which gives misleading or biased information about certain risk head. It may be noted here that, the lesser the coefficient of variation the higher is the consistency which ultimately shows to have a normal behaviour of opinions.

6.2.5 Risks at the transporting agency level

For the transporting agencies it is greatly experienced that, the increasing fuel prices add to the existing transporting problems. Wherever the scattering cooperative societies and the retail outlets is a matter of worry, there the bad conditioned roads and the volatility in fuel prices badly affect the agencies. In most cases the natural disasters and the hazards risks (fire, sabotage etc.) also hamper the business activities of these agencies. It is seen that these agencies collect cash from the retailers on behalf of the production plant and pay the same to the marketing department for getting the products for the next day.

Sometimes the cash is missed/theft underway causing loss to the agencies. Again, since these people behave as an interface between the firm and the retail outlets, a proper public relation mechanism needs to be established but unfortunately the driver and the helper those who work on behalf of this lack in expertise. Any deviation in agreed upon rules and regulations in operations make them responsible to get penalised.

Table 6.6: Risk scores at the transporting agency level (figures are in scale values)

Risk heads	Probability	Severity	Impact	Std. devi.	CV
Damage and spillage during transit	2.40	3.05	2.00	0.72	36.00
Lack of skilled workforce	2.90	2.55	1.82	1.04	57.00
Financial risks	2.90	2.60	2.25	1.33	59.00
Volatility in fuel/energy prices	3.15	3.30	2.55	1.36	53.00
Hazard risks (fire, sabotage etc.)	4.45	4.60	4.20	1.10	26.00
Communication distortions	1.80	2.95	1.60	1.14	71.00
Perishability	3.05	3.00	2.50	1.43	57.00
Transportation risks	3.90	4.00	3.40	1.10	32.00
Low profit margin	3.70	3.60	3.35	1.42	42.00
Imposed penalty	3.00	3.20	2.30	0.66	29.00
Capacity constraints	2.65	3.10	2.10	0.64	30.00
Intense competition	3.60	4.05	3.20	1.15	36.00
Delivery risks	3.35	2.40	2.10	0.44	21.00
Lack of coop. & info. sharing	3.90	3.95	3.55	1.23	35.00

The risks like, "hazard risks, transportation risks, intense competition among third party logistics providers and lack of cooperation & information sharing" have been carried forward to find the significant ones and the rest of the risk heads have been dropped from here itself to curb "common method bias (CMB)". Though risks like, "damage and spillage during transit, imposed penalty for various reasons, capacity constraints and delivery risks" have got consistent opinions (C.Vs less than 36 percent), still they have been dropped from the list because of their low means for probability, severity and impact variables.

6.2.6 Risks at the retail outlet level

Untimely delivery, delivering damaged products and increasing the price of the products, opening up of federation-owned parlours under the same operational area of the retail outlets put the retailers at stake in their daily business activities. Sometimes because of transportation problems the product delivery stops which cause inconvenience to both retailers and consumers. The situation is more acute in the semi-urban and rural areas in getting the product and service of the federation. These days where most of the businesses run on credit, it is seen that the chain only considers the advanced cash payment system for the retail outlets. This is causing a serious concern among the retailers to expand their business. Most retailers also claim that the products are of inferior quality and unable to meet the customers' expectations. In the competitive market place this is taken seriously by both the retailers and the customers. Oftentimes the duo complains the prices of the products are incompatible with respect to their quality standards.

Table 6.7: Retailers' opinions on various risks (figures are in percent)

Risks	Probability					Severity					Impact				
	Very low	Low	Neutral	High	Very high	Insignificant	Minor	Neutral	Serious	Catastrophic	Very low	Low	Neutral	High	Very high
Financial risks	14	42	26	17	1	21	27	23	25	4	45	41	9	5	0
Ineff. in inventory mgmt	6	37	23	30	4	19	24	29	18	10	36	27	20	16	1
Product shortages	2	5	29	50	14	13	13	24	28	22	16	20	20	29	15
Supplier unreliability	23	45	21	8	3	25	43	16	7	9	69	13	11	7	0
Demand unpredictability	9	18	31	29	13	21	17	26	25	11	14	22	12	29	23
Lack of coop & inform.	15	39	21	18	7	15	28	42	9	6	44	33	16	4	3
Intense competition	18	16	21	30	15	17	26	18	23	16	36	27	15	19	3
Perishability	17	32	37	14	0	32	33	19	8	8	52	33	8	7	0
Delivery risks	37	30	18	11	4	39	24	24	10	3	61	22	11	3	3

The opinions of the retailers in connection to risks and uncertainties have been considered to detect the vulnerabilities related to distributions. It is seen from the table that, 10 risk factors are explored and queried for to identify the major ones. It can be seen from the table that, “product shortages and demand unpredictability” are the two major risk heads identified. Both cases, higher responses are obtained in favour of the statement while lesser responses are obtained against the statement.

In case of “product shortages” 44 percent of the respondents opine it to be a high risk concern where as 20 percent kept quiet and 36 percent of them opine the opposite of what the earlier respondents reveal. Since the impact values are the reflections of the probability and severity values, it can also be seen that, the greater proportion of the respondents opine the risk to be a high “probable and severe” being at the right side of the scale. This comparison replaces the calculation of coefficient of variation and curbs down the inconsistency obtained from the respondents’ opinions. So finally, these two risks have been taken further to reach at a conclusion with significant results.

6.2.7 Risks at the customers level

Consumers are gradually becoming more aware and quality conscious. Keeping view to the changing customers the processing plants are upgrading the quality of the products which is becoming more costly giving rise to price rise. The price rise is sometimes adversely affecting the business of the plants. Because of the unreliable transportation resources the distribution of the milk and other dairy products gets delayed which ultimately delay the delivery of the product at the customer level leading to customer dissatisfaction.

The leakage and less content of the products in the packets also a concern for the customers. Some cases the retailers charge more than the maximum retail price (MRP) for the sake of refrigeration which is undesirable in their part. It is also unethical to charge more than the MRP for the sake of storing which sometimes leads to altercations with the customers and tarnishes the image of the brand as a whole in the market place. Though, customers (consumers) are not the part of the supply chain still some of their problems related to consumption of dairy products have been considered in apprehension of supply chain break-down with high customer dissatisfaction. There are six factors of risks and uncertainties detected in this case of which “product reliability and incompatible price” are seemed to be a concern for the supply chain.

Table 6.8: Customers' opinions on various risks (figures are in percent)

Risks	Probability					Severity					Impact				
	Very low	Low	Neutral	High	Very high	Insignificant	Minor	Neutral	Serious	Catastrophic	Very low	Low	Neutral	High	Very high
Lack of product quality	2	12	22	47	17	3	7	40	18	32	15	16	48	20	1
Lack of produ. reliability	4	14	24	31	27	8	14	29	25	24	10	14	35	23	18
Lack of product safety	36	31	22	8	3	21	22	22	18	17	54	34	6	5	1
Incompatible price	5	16	28	34	17	18	17	25	21	19	10	30	17	34	9
Supplier unreliability	10	18	32	28	12	7	20	36	24	13	18	37	27	12	6
Unrespons. to complaint	18	33	26	14	9	25	22	21	17	15	48	26	11	10	5

It can be seen from the table 6.8 that, respectively 41 and 43 percent of the respondents opine in favour of these statements to be redressed soon while 24 and 40 percent have responded against the statements indicating no complaints in this regard. Furthermore, respectively 35 and 17 percent have opined for the point "neither high nor low" in both cases. Summarising, it can be concluded that, these two risks heads are really matter of worries for the end part of the supply chain. Other risk heads are opined exactly in a reverse manner and need to be dropped henceforth.

6.3 Multiple Regression Analysis to Identify Significant Risks

In case of "multiple regression" there is a dependent variable (y) and several other independent variables (x_i) of which the statistically significant ones are drawn through analysis of variance (ANOVA).

Mathematically:

$$y = f(x_1, x_2, x_3, \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots),$$

Where y is dependent variable (overall risk),

$x_1, x_2, x_3, \ldots\ldots$ are independent variables (independent risks).

In this case 34 factors of risk explored from the field and preliminary analysis is made based on the opinions of the respondents from various capacities of which 21 factors have been carried forward for the regression analysis. While some of the risks are repeating in various components, some are solely meant for a specific component. The opinions for each case are collected according to their suitability to a particular stakeholder. For an instance, "low level of milk procurement" is not only a problem for the union rather a problem for the dairy plant too. It increases the transportation cost at the BMC level, being at the procurement side and decreases the output level of the production plant being on the distribution side of the supply chain. The following tables will depict the results of multiple regressions conducted for various components separately.

6.3.1 Component-wise model summary of overall risk perceptions

Table 6.9: Component-wise coefficients of determination for risks

Components	No of risks	R	R square	Adjusted R square	Std. error of estima.	Durbin-Watson
Milk producer	5	0.75	0.57	0.56	0.25	1.96
Dairy coop. society	5	0.72	0.51	0.50	0.29	2.06
Bulk milk cooler	5	0.78	0.61	0.53	0.26	1.99
Production plant	6	0.86	0.74	0.63	0.22	1.98
Transporting agency	4	0.71	0.51	0.40	0.28	2.09
Retail outlet	2	0.72	0.52	0.51	0.40	2.00
Customer	2	0.76	0.57	0.57	0.32	2.03

The production plant which is entangled by many of the risks - is the highest risk taker whereas the customer or the consumer, who only purchases or consumes the products does not have many problems in this case to deal with. Even if the customer, who does not have any role in the operation of the supply chain, still plays a vital role in accepting or rejecting the products coming out of the manufacturing plant. Without the loss of generality, it can be said that the success or the failure of the supply chain rests on the end users. The problem at the end point of the supply chain is another problem/risk for the upstream member(s). On the procurement side of the supply chain, MPs, DCSs and BMCs each deal with five numbers of short listed risks carried from the pool of risks. Transport agencies and the retail outlets respectively assumed to have dealt with four and two risk heads in this case. The overall risk, in all the cases, does a good job in explaining the independent variables with an average correlation value of more than 75 percent, which is depicted in the column "R". The "R square" values indicate the degree of variability in the overall risk subjected to the impact of the independent risks. On an average, 58 percent of the variability in the overall risk has been contributed by the total number of risks mentioned for each individual component. In case of the production plant, six independent variables mentioned in the table contribute to the 74 percent of the variability in the overall risk thereto. The values of "R square" are nothing but the fit of the respective models with respect to their independent variables, which is also mentioned in the "regression rows" of the ANOVA table 6.9A.

It may be noted that, some of the risk items have been dropped from the initial list in order to bring transparency in the area by minimising the auto-correlations in each of the components. All the risks being discussed are representing 53 percent (Adjusted R square value) of the total risks – had the population been studied instead of the sample. Durbin-Watson statistics are also displayed to overrule the auto-correlations among the various risk heads. Since all the values displayed are nearing to "2.00" auto-correlations are virtually not found and hence the models fitting are justified.

6.3.2 Component-wise risk perceptions in the dairy-food supply chain

Table 6.9A: ANOVA - various components' risk perceptions

Components	Sum of squares		df	Mean square	F statistics	Sig.	Risk propositions?
Milk producer	Regression	29.86	5	5.97	89.63	0.00	Accepted
	Residual	22.72	341	0.07	-	-	-
	Total	52.58	346	-	-	-	-
Dairy cooperative society	Regression	14.44	5	2.88	32.15	0.00	Accepted
	Residual	14.55	162	0.09	-	-	-
	Total	28.99	167	-	-	-	-
Bulk milk cooler	Regression	2.62	5	0.52	7.78	0.00	Accepted
	Residual	1.69	25	0.07	-	-	-
	Total	4.31	30	-	-	-	-
Production plant	Regression	1.93	6	0.32	6.34	0.00	Accepted
	Residual	0.65	13	0.05	-	-	-
	Total	2.58	19	-	-	-	-
Transport agency	Regression	1.21	4	0.30	3.89	0.02	Accepted
	Residual	1.16	15	0.08	-	-	-
	Total	2.38	19	-	-	-	-
Retail outlet	Regression	25.51	2	12.75	78.85	0.00	Accepted
	Residual	23.77	147	0.16	-	-	-
	Total	49.28	149	-	-	-	-
Customer	Regression	45.56	2	22.78	210.47	0.00	Accepted
	Residual	33.77	312	0.11	-	-	-
	Total	79.33	314	-	-	-	-

The regression values are those which show the degrees of variability in the dependent variable corresponding to the independent variables (also R square value) and the residuals are the values which remain to be unaddressed by the regression model being carried out. The combined table mentioned above pertaining to the analysis of variance says that, at least two of the risks in each component do not have same mean, in the sense that the mean impact of the risk varies depending upon the probability, severity and impact of it. In addition to this, it clearly conveys meaning that the dairy-food supply chain has lots of flaws which hamper its operations. There are several risks in the chain which are statistically significant whereas some are insignificant and don't have much impact on it, can be discarded either without further analysis. All the ANOVA tables for each of the components have been adjoined together as above. In each case, the independent risks proposed are found to be significantly affecting the overall risks and hence the hypotheses of existence of risks also hold good since "p values" are lesser than "0.05".

Table 6.9B: Regression statistics of independent risk variables

Components	Risk heads	B	Std. error	Beta	t stat.	Sig.	Tol.	Category
Milk producer	Constant	1.15	0.09	-	13.55	0.00	-	-
	Low milching cattle	0.11	0.01	0.38	10.48	0.00	0.97	High
	Illiteracy of milk producers	0.11	0.01	0.32	8.80	0.00	0.96	High
	High cost of fodder & medicines	0.12	0.01	0.30	8.19	0.00	0.95	Medium
	Non-remunerative price of milk	0.08	0.01	0.24	6.56	0.00	0.94	Low
	Seasonal fluctuations in prod.	0.07	0.01	0.21	5.89	0.00	0.96	Low
Dairy cooperative society	Constant	0.99	0.14	-	7.14	0.00	-	-
	Non-remunerative price of milk	0.13	0.02	0.40	6.78	0.00	0.91	High
	Illiteracy of milk producers	0.12	0.02	0.34	5.80	0.00	0.93	High
	Lack in leadership skills	0.11	0.02	0.27	4.76	0.00	0.95	Medium
	Lower level of milk procurement	0.09	0.02	0.23	4.12	0.00	0.97	Low
	Process/control/quality risks	0.08	0.02	0.21	3.60	0.00	0.88	Low
Bulk milk cooler	Constant	0.97	0.32	-	3.00	0.01	-	-
	Lower level of milk procurement	0.23	0.07	0.50	3.46	0.00	0.74	High
	Delivery risks to the plant	0.12	0.05	0.35	2.66	0.01	0.91	Medium
	Process/control/quality risks	0.07	0.03	0.28	2.17	0.04	0.95	Low
Production plant	Constant	1.40	0.56	-	2.50	0.03	-	-
	Logistical risks	0.21	0.07	0.63	3.22	0.01	0.52	High
	Process/control/quality risks	0.10	0.06	0.29	2.64	0.03	0.62	Medium
Transport agency	Constant	0.82	0.50	-	1.66	0.12	-	-
	Hazard risks	0.17	0.06	0.54	2.71	0.02	0.82	High
	Logistical risks	0.16	0.06	0.52	2.65	0.02	0.86	Medium
Retail outlet	Constant	0.84	0.10	-	8.68	0.00	-	-
	Demand unpredictability	0.22	0.03	0.49	8.36	0.00	0.97	High
	Product shortages	0.21	0.03	0.46	7.86	0.00	0.97	Medium
Customer	Constant	1.30	0.05	-	26.35	0.00	-	-
	Lack of product reliability	0.26	0.02	0.50	13.20	0.00	0.95	High
	Incompatible price w.r.t quality	0.19	0.02	0.47	12.38	0.00	0.95	Low

Of the 21 risks identified earlier, 15 different risks are traced to be significant and the rest five are insignificant, which are already depicted in the previous tables. The significant risk factors ($p < 0.05$) have been mentioned in the table 6.9B with their respective "t statistic" values. Since these values can be used to compare variables within a supply chain component, the coefficients of independent variables (B and β) are not being considered here to avoid exaggeration.

Multi-collinearity has been tried to avoid in all the cases as depicted in the column marked "tolerance". The more the values of tolerance beyond "zero", the lesser is the multi-collinearity, which is an unwanted situation to be dealt with. The inverse of it is the "variance inflation factor (VIF)" which beyond "10" indicates a clear multi-collinearity in the analysis and need to be avoided. Since tolerances are mentioned in the table, the idea of showing VIFs is dropped here. In all cases, the tolerances fall below "1.00" much above the desired limit of "0.2" and hence the risks mentioned above clearly reflect the overall risk. The t-statistics values greater than "2" and less than "-2" are usually considered to segregate significant and insignificant variables. Based on the "t-statistics" each risk is categorised. In this respect, the item with more than average of the "t-statistics" values are termed as "high risk" and less than average values are termed as "low risk". The mediocre values have been considered to be the "medium risk" factors.

Keeping view to these values respectively eight, six and two areas are categorised as high, medium and low risk areas. While some of these risk areas repeat across components, others won't repeat and solely meant for concerned stakeholders. It may be noted that, if a risk appear in one category, then subsequent appearance of the same is compared with the former category and decision is taken on its placement in the table. For an instance, non-remunerative milk price is a major concern for the producer-members and hence categorised as high risk at the dairy cooperative society level but is categories as low risk at the milk producer level. Keeping view to the qualitative judgement it is categorised as a high risk item. The same logic prevails throughout the analysis to categorise them both quantitatively with due priority to the qualitative arguments as well.

6.4 Impact of Risks on Supply Chain

In total, 15 risk factors are detected across the supply chain and categorised as high, medium and low (table above). These risks directly or indirectly affect the efficiency and effectiveness of the supply chain with around 60 percent of variability. The impact of these risks and uncertainties across various level of the supply chain are being discussed below.

6.4.1 Low milching cattle

Rearing of low milching cattle brings down the production and hence increases the cost of production. Earlier the factors of milk production with their regression coefficients have been discussed in detail. Here the immediate impact of the risks on the cost of production is being discussed. It has been seen that, the higher is the production; the lower is the cost of production per litre of milk. This is the minimum when somebody is producing up to 60 litres of milk per day. Beyond 60 litres of milk production under certain circumstances, the cost is again going up which is depicted in the figure below. But for a typical milk producer, who owns one to two cattle (almost 45 percent) produces below 10 litres of milk per day, each 5 litre in a shift. This clearly says, that average milk from a cattle is around 2 litres per shift (morning/evening) which obviously can't cater to decrease the cost of milk production at one go. It is also seen that at 99 percent level of confidence, cost of production and average daily production of milk are moderately correlated (0.40).

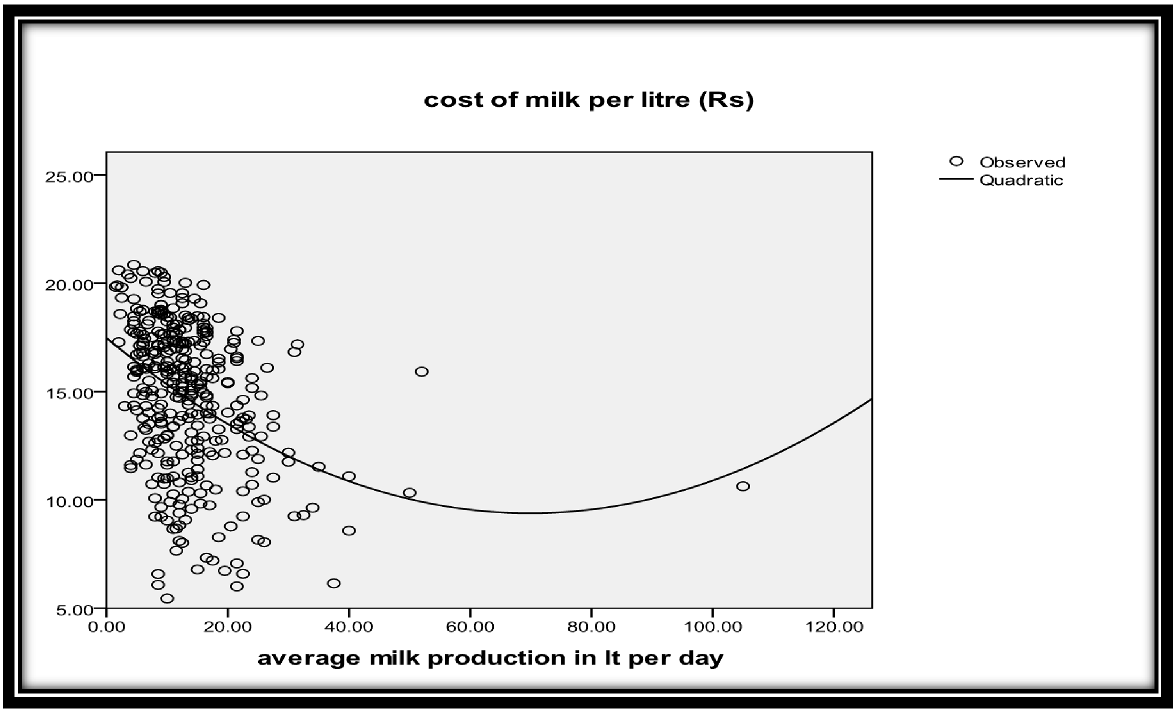


Figure 6.1: Cost of production vs. milk quantity

It can be seen from the figure 6.1 that, there is a drastic change in the cost of production till 60 litres of milk production per day.

6.4.2 Illiteracy of the milk producers

There is no proper correlation found between the cost of production and the illiteracy of milk producers still, in most of the cases it is seen that, it creates problem in understanding the intricacies of milk production as per the norms and standards fixed by the federation from time to time. This sometimes brings up cost of production and quality deterioration at their level. Lack of understanding of the business facts bring down bargaining power at the DCS level and hence in most of the cases they get underpaid for their produce; which ultimately snatches their avocation being suffered for a long time. In this way the risk not only makes the milk producers as sufferers rather it affects the DCSs at same capacities.

6.4.3 High cost of fodder and medicine

Cost of fodder and medicine constitute almost 70 percent of the total cost of production in any typical dairy farm. If the fodder and medicine cost increase by just 10 percent of the market price then, the cost of milk per litre is increased by Rs.1.48 to make it to Rs.16.25 per litre (earlier Rs.14.77 per litre). But concurrently, the selling price of milk does not increase and hence the percentage loss is found to be more. If the selling price per litre is taken as Rs.13.62 then the loss is dipped further by 128 percent. It may be noted that, in rare cases profit has been detected unless there is a significant level of milk production.

6.4.4 Non-remunerative price of milk

Non-remunerative price does not affect the cost or quality of milk directly but certainly won't entice the producers from the unorganised sector to join the societies. Moreover the lower price of milk incurs losses in their case and hence makes them bankrupt over a period of time which compels the milk producers to sell their milching cattle. It is also seen that, an average year of experience of a milk producer in dairying is more than seven years while average time he/she spends in the societies is lesser than half of the former (four years). It shows the milk producers join societies much later than they start their business and after being there for a specific period of time they leave the organisation. If not, informal milk selling becomes a part of their business without the knowledge of the secretaries/supervisors of the societies.

At the DCS level, the non-remunerative price of milk dissuades the producers from joining societies. It is seen that, on an average one third of the milk producers from a locality are involved with the societies. On any given period of time, pouring members (active members) are found to be two third of the total members, which could be attributed to the non-remunerative price of milk. This not only brings down the involvement of producers in the system rather substantially affects the collections at their disposal.

6.4.5 Seasonal fluctuations in production

Seasonal fluctuation of milk production hampers the profit by increasing the cost of milk production. The milk production during lean seasons (March to August) decreases by almost 30-40 percent and hence increases the cost of milk production substantially by 60 percent over the flush seasons. It is detected that, the cost increases by 25 percent over the average cost of milk production unlike cost of production in flush seasons. Concurrently it decreases the profit substantially and put the milk producers at stake.

6.4.6 Lack of leadership skill of secretaries

Lack of leadership skill incapacitates secretaries to disburse their duties smoothly at the DCS level. This makes them inefficient to motivate the milk producers of a certain locality to join societies too. Due to this problem the secretaries of various DCSs can't put forth the demands of the members before the union/federation and hence indirectly arouse the discontentment among the member producers. Continuing with the problem for long run the organisations might come to defunct situation. Since the secretary is the only official at the society, he/she bears the blame once it comes to a defunct position.

6.4.7 Low level of milk procurement

Lower involvement of the milk producers in the societies brings down collections and lower level of collection in return increase the cost of collections and decrease profit substantially thereto. It is found that, the correlation between average milk collections and cost of collections is around 0.45 (significant at one percent). Though the correlation is not that impressive here still it has an impact on the cost of collections.

It is detected that, cost of collections in the flush seasons and lean seasons are respectively Rs.0.33 and Rs.0.16 per litre respectively with a mean of Rs.0.25. The cost of collections is doubled in the lean seasons due to decrease in the collections at the DCS level. Though both net profits and return on investments are found to be affected by this; the former is affected substantially by 90 percent (significant at five percent level). These high deteriorations of profit make the DCSs instable and sick in the long run to be wiped out finally.

At BMC level the lower level of milk procurement has a tremendous impact. It substantially decreases capacity utilisation of the plant which ultimately increases the cost of chilling and transportation by bringing down the profit. It is found that, BMCs' on an average incur Rs.1.98 per litre of milk towards cost of collection, chilling and transportation of which respectively 19 percent (Rs.0.37) and 25 percent (Rs.0.50) of it is expended towards secretaries' commissions and head loaders' compensations. Respectively 18 percent (Rs.0.36) and 32 percent (Rs.0.64) is expended towards the cost of chilling and transportation. The rest is expended towards housing, maintenance and depreciations of the machineries. Clearly the lower level of collections will bring up all these costs and reduce the monthly profit drastically. Wherever the average profit per litre of milk is calculated to be Rs.0.15 with an average collection of 24,450 litres per month; the deterioration in the collections will severely impact the profit. It may be noted here that, most of the BMCs (40 percent) are incurring losses whereas the average return on investment is around 4.6 percent.

6.4.8 Delivery risks

At the BMC level if the milk is not delivered to the production plant on time then the production processes will be seriously affected at the plant but before that, it might increase the risk of perishability on the way and any delay in it will incur more chilling costs. Already it is seen that, the cost of chilling is around 18 percent of the total collection costs, so delaying in the delivery process will lead to incur more costs in chilling.

6.4.9 Process/control/quality risks

At DCS level - the effect of the quality of milk is found to be somewhat disastrous. There is a deduction in amount accrued from the payment if the quality of milk doesn't match with the specified TMS level (12.5 percent). Almost two third of the secretaries claim - to get a TMS level of 12.5 percent in the milk production is an ideal condition which depends on proper feeding procedure. In 60 percent of the cases the TMS level is found to be below these specifications and lead to deductions in amount. So the probability of meeting quality related problems is found to be more than 0.60. Ultimately, the amount finally received from the union put them in trouble to distribute it among the producer members proportionately. Also there is a high degree of correlation found between the quality of milk and its selling price at their level (98 percent).

Since the BMCs process the milk collected from the DCSs, there is an every scope of machine failure which obstructs the chilling and foster perishability. Fortunately, all of them have two compressors which capacitate chilling an ongoing concern and hence there is no downtime discovered. But due to the lack of collections, the average capacity utilisation of the plant is found to be around 50 percent. Only 13 percent of the plants found to be operating with more than 75 percent of capacity utilisation. Though operating the machineries by unskilled manpower puts the machineries in obsolescence sometimes still this is not reflected in the list of significant risks – may further need more clarifications at their behest. As long as quality is concerned, they are also not out of purview of this issue. In almost half of the cases the collections won't meet the desired specifications which decrease the profit and return on investments. The lower the TMS the lower is the profit, which is found to have an outstanding correlation of 0.98.

In case of the production plant, the machine downtime is found to be insignificant (less than 0.01 percent probability) with a capacity utilisation of around 60 percent due to lack of procurement. Though there is no downtime found still, there is always a scope for the machinery failure due to improper handling (10 percent probability). But immediately after the break down the machineries get repaired and hence downtime is virtually ruled out.

In 20 percent of the cases it is seen that, the poly-pack machines fail because of overlapping of plastics. There is always a scope for casualties in the plant and hence adequate measures have been taken there to curb all these still, the eruption of the same can't be ruled out in any given point of time. Since the exact statistics in this connection have not been received, it is avoided to be cited here. The single production plant which caters the dairy product-needs of three districts with a geographical area of more than 16,729 sq kms always faces difficulty from controlling issues related to production and distribution. Since quality in production has become mandatory for the plant to meet the customers' satisfaction, the lower TMS content of milk collected put it under stake.

6.4.10 Logistical risks

The flow of materials from one place to the other matter inevitably concern a lot for the production plant. The delay in the process, deteriorate production and distribution of the same to the retail centre to be sold to the end users sometimes causing perishability of products on the way. It is explored that, the logistical risks only contribute to more than half of the total risks experienced at the production plant. Indirectly it brings in customer dissatisfaction which may lead to loss of market share at the downstream.

The distribution of the items is taken care of by the transport agencies. The deviations in making the product available to the retail outlet create discontentment among them and lead to file complaints at the production plant authorities. Since the products are highly perishable and making them reach on time is a key issue. In order to confine to the stipulated timings and promise, the logistical flow is made highly agile which sometimes (20 percent cases) faces road casualties leading to loss of property and lives.

6.4.11 Hazard risks

The risks like fire, sabotage, accidents or bandhs by political parties etc. could be attributed to hazard risks. This kind of risks, though applicable to BMCs and the production plant, still found to be crucial for the transport agencies. The transport agencies are basically the third party logistics providers, who work for the out-bound logistics sake, selected through a bidding process. Once the products handed over to these agencies at the plant, the onus of these items are borne by them and any deviation in distribution lead to penalisation. So these agencies are highly susceptible to hazard risks leading to bring down profit and sometimes loss of lives at their disposal.

6.4.12 Demand unpredictability

Unpredictability of demand in the market place doesn't allow the retailers to put exact advance in front of the production plant. Though in case of packaged milk sale, the amount of it through home delivery is known, still nothing is known about the counter milk sale. All it depends upon the customers' turn up at the counter to purchase the same - which is absolutely a chance. In this connection, the experience of a retailer about the market which he/she deals in matters a lot. It is seen that, the counter sales of packaged milk is more than half (52 percent) of total milk sales and the rest is made through the home delivery process. Higher the amount of milk to be sold at the counter the greater is the difficulty in predicting the demand. Similar kind of problem is also noticed in case of sale of dairy products. Since no credit system prevails in the system, the order is made on the basis of advance payment and hence risk aversion in case of putting higher order has been rampant. Since all these orders reflect the production output of the plant, it operates in a sub-optimal level in meeting the demand.

6.4.13 Product shortages

At this case, product shortages are experienced from the production plant especially in the festive seasons. It is highly seemed to be a concern for the semi-durable products (like ghee) which is not manufactured at the plant rather procured from other production units. The desired amount of requirement is drastically lesser than the supply being made in this case. It is seen that, the OFR (order fill rate) in their case is 70 percent while PFRs (order fill rates) of respective products is averaged with more than 75 percent except ghee (45 percent). Though the risk of "product shortages" is not being opined by the production plant respondents still felt to be one of the major concerns.

The OFR of 70 percent is still at minimum and a result of lower production and supply creating product shortages. The PFRs and OFRs are in some cases are found to be as low as 30 percent and 20 percent respectively depicting a higher unfulfilled demand and risk aversion attitude of the retailers to extend their order. Though demand unpredictability and product shortages seem to be apparently same still this is not true. While the former is felt from the downstream members (customers), the latter is experienced by the upstream member (production plant).

6.4.14 Lack of product reliability

Variations in quality and taste of the dairy products lead to customer dissatisfaction and are apparently seen to be threats for the federation as a whole. Though this is a problem felt by the customers, still found to be a concern for the entire supply chain since they are the epicentre of the whole process. It is found that, 37 percent of the overall problems with the products lie with this issue. Since the customers today have hardly any other option, they endure with the federation but tomorrow if the problem persists there is every possibility of switch over to competitors' brand leading to loss in market share.

6.4.15 Incompatible price w.r.t quality

Lack of reliability of products together with this risk factor lead to more than 57 percent of the variability in the problems reflected in the customers' buying behaviour. Incompatible price only increases the risk factors by another 33 percent, found to be another major cause of customer dissatisfaction. Ultimately, this adds to the risk pool of other upstream members especially for the production plant, where the basic problem lies with the quality not with the price. Quality and price respectively are concerns for 90 percent and 30 percent of the customers purchasing the brand depicting the importance of the quality in the process. But when it comes to the combination of the duo quality is found to be inferior to the price and hence the mismatch comes up as another threat for the downstream supply chain.

6.5 Hypotheses for All Stakeholders Regarding Risks and Uncertainties

At this stage the hypotheses are meant for all the stakeholders of the supply chain. They are as mentioned below:

(i) Risk and uncertainties exist at each level of the supply chain: From the table, the hypothesis, "risk exists at each level of the supply chain" is accepted (p values < 0.05) for the respective components. It can also be seen from the "coefficient of determination" and "identifying potential risks" tables that, at least one of the risks has been found to be significant. The significant risks factors are categorised as "high, medium and low" where at least one risk is termed to be "high risk". This is enough evidence to justify the claim.

(ii) Endogenous risks have more chances of occurrence than exogenous ones: The table describes the summary of significant risks for the entire supply chain. It is seen that, out of 15 risk factors eight are endogenous (internal) and the rest seven are exogenous (external). So the probability that an endogenous risk will appear is 54 percent, while it is 46 percent in case of an exogenous one. Since the endogenous and exogenous risk probabilities do not differ significantly so it can be said that all risks are equally likely and hence the assumption is deemed to be rejected.

6.6 Conclusion

The dairy-food supply chain is highly a riskier business concern to deal with. No matter what the precautions taken, risks and uncertainties can't be ruled out from the industry. Since it is not possible to avoid them, a proper risk redressal mechanism could at least minimise the impact. The summary and strategies for the high risk areas have been mentioned in the summary and conclusion chapter given below. The high risks are the crucial ones and need to be addressed soon while medium and low risks are not to be neglected at the same time. Depending upon the risk redressal mechanism of an organisation and the intensity of the risks, they could be avoided, shared, transferred or mitigated with a suitable strategy.

CHAPTER VII

SUPPLY CHAIN COORDINATION AND PERFORMANCE

This chapter discusses about the supply chain coordination and performance issues. Coordination among the partners has been one of the key issues for the supply chain operations. In order to have a better supply chain coordination mechanism, several responsible factors have been already discussed in the literature. In this context the following factors have been considered to measure the degree of supply chain coordination among all its interfaces. Performance measurement is also another important aspect of the supply chain which is discussed in the ongoing chapter.

7.1 Supply Chain Coordination

As described in the dairy food supply chain (figure in introduction chapter) there are seven stakeholders in the system and sought each other's help and cooperation in disbursing duties. In this context the two immediate stakeholders who report each other in the supply chain are mentioned below in the form of an interface. At the first stage the opinions are gathered to analyse the stakeholders' views on various coordination variables and in the later stages the degree of coordination is measured through the multiple regressions.

- Milk Producer vs. Dairy Cooperative Society (MP - DCS)
- Dairy Cooperative Society vs. Bulk Milk Cooler (DCS - BMC)
- Bulk Milk Cooler vs. Production Plant (BMC - PP)
- Production Plant vs. Transport Agency (PP - TA)
- Production Plant vs. Retail Outlet (PP - RO)

7.1.1 Milk producer vs. dairy cooperative society interface

Opinions of the secretaries on behalf of the DCSs and its members regarding the coordination indicators have been raised. The major factors which are required for the successful coordination in a supply chain are being discussed step-wise. It may be stated that some of the statements are written in the negative manner whereas others are written positively. For an instance "lack of trust worthiness" is a negative statement whereas "responsibility sharing" is a positive statement. So in case of a negative statement, opinions raised in the left hand of the scale deny the truthfulness of it and hence treated as if they agree with positive side of the statement and vice-versa. According to the consent of the secretaries, internal resources like (telephone, internet etc.) which are utmost required for the interfaces to have, found in almost two third of the cases and other one third does not have the same.

Table 7.1: Opinions on coordination for MP - DCS interface (figures are in percent)

Variables for coordination	Strongly disagree	Disagree	Indifferent	Agree	Strongly agree	Total
Insufficient internal resources	1	7	27	44	21	100
Lack of trustworthiness	9	16	36	22	17	100
Lack of commitment	12	15	27	30	16	100
Forecast should be done and shared	4	14	27	26	29	100
Information collecting and sharing	2	16	21	26	35	100
Believing in long term relationships	3	11	23	30	33	100
Hard work for long term relationships	4	13	22	30	31	100
Closely working with each other	10	19	18	31	22	100
Responsibility sharing	13	16	22	22	27	100

This is found to be a major barrier in the communication process which in turn a key instrument in the whole coordination process. Trustworthiness is found to retrieve 25 percent of the responses which is drastically low and is a crucial concern for the interface to concentrate. In the similar way, commitment to each other is found in just 27 percent of the cases while forecasting (regarding the milk collections) is somewhat done in half of the cases.

Information collection and dissemination of the same is again one of the major milestones in coordination process. Unless the information is shared with the downstream members, decision making on a certain issue could be difficult. Almost in half of the cases, the information is kept as secret (which may have importance for other chain members) and is not shared. Other half of the respondents are found to share the necessary information in this interface. In case of long term relationships and maintaining of the same is noticed in more than 60 percent of the cases. Though the DCSs and its members are the integrated parts of the system; still working together (joint decision making) and responsibility sharing is found to be in almost half of the cases raising concern on overall coordination of the system.

7.1.2 Dairy cooperative society vs. bulk milk cooler interface

Below are the opinions of the plants-in-charge of the bulk milk coolers/chilling centres regarding the coordination variables in DCS - BMC dyad. From the table below it can be seen that more than two third of the respondents say, their internal resources don't allow them to have a proper contact with the upstream and downstream members. Only 10 percent cases are found to be having all sort of requirements and are in a better off position to handle it. Low level of trust and commitment decreases the procurement they reaffirm but the quantitative figure in this case is difficult to cite.

Table 7.2: Opinions on coordination for DCS - BMC interface (figures in percent)

Variables for coordination	Strongly disagree	Disagree	Indifferent	Agree	Strongly agree	Total
Insufficient internal resources	1	9	12	38	40	100
Lack of trustworthiness	4	12	21	21	42	100
Lack of commitment	1	9	24	36	30	100
Forecast should be done and shared	0	6	12	46	36	100
Information collecting and sharing	6	6	12	49	27	100
Believing in long term relationships	21	36	18	13	12	100
Hard work for long term relationships	15	9	39	22	15	100
Closely working with each other	9	15	18	40	18	100
Responsibility sharing	12	12	36	25	15	100

More than 60 percent of the plant managers and operators depict that due to low level of trust and commitment of the secretaries and milk producers; procurement operation is seriously affected in the system which ultimately compelling the BMCs to get sick and defunct most of the times. Almost 80 percent of the cases information is collected and shared including the future collections (forecasts) with the union or other authorities to make the future agenda.

Buyer-supplier relationship is also another crucial case in supply chain coordination. Here it is figured out to be drastically low because of several reasons. One of this could be due to deductions from the payment for the sake of variations in TMS, which brings out difficulty in disbursing remuneration to the milk producers and hence put the relationship at stake. Another reason is due to lack of field visits of the senior officials to the DCSs/BMCs during emergencies. In this way it is detected that the relationship is not very well off between the DCSs and BMCs which is reflected in their opinions. Even if they work closely (58 percent cases), the responsibility is not much shared (60 percent) and is mostly held by the union/federation authorities.

7.1.3 Bulk milk cooler vs. production plant interface

Opinions of the respondents at the production plant are not mentioned in the form of frequency table due to their fewer responses and hence the mean score of the values have been considered for each statement being the second best option after ANOVA outputs.

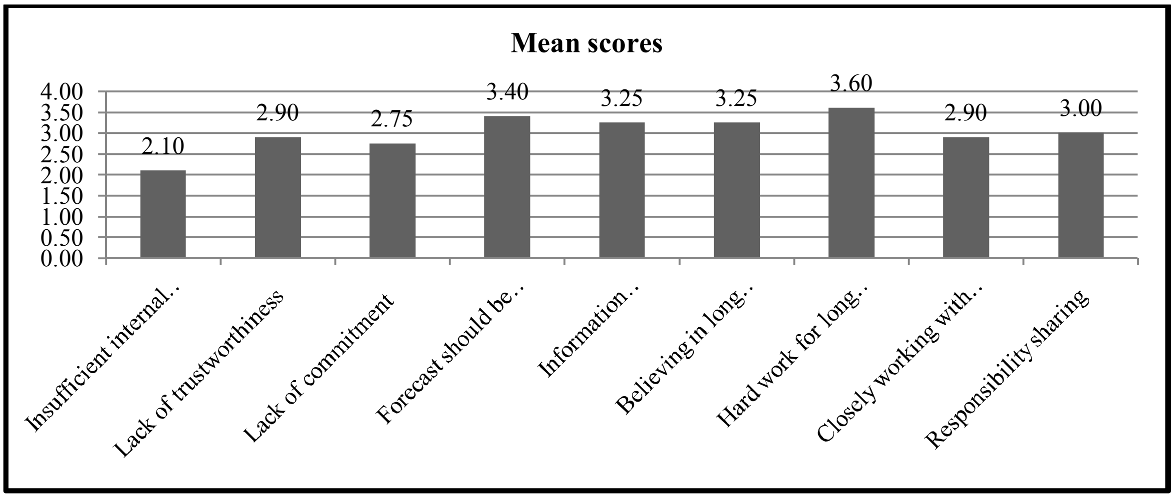


Figure 7.1: Opinions on coordination for BMC - PP interface (figures in scale values)

At this interface, the mean score for the "insufficient internal resources" is 2.10 indicating a higher figure for the opposite and hence found to facilitate the coordination process – felt by the production plant authorities. Lack of trustworthiness and commitment which are further drawbacks in the coordination process found to have means of 2.90 and 2.75 respectively. It may be stated here that, in these three cases higher values depict negative indications because of the very nature of the statements.

Forecasting, information sharing, relationships between the upstream and downstream members are having means of more than 3.00. Joint decision making (closely working) is still not in a good position (mean of 2.90) and lot more is to be done in this case to continue the process till supply chain collaboration. Responsibility sharing is somewhat found to be in a better position to have a mean of 3.00. Combinely joint decision making (closely working and responsibility sharing) gathers a mean score of 2.95 stating the degree of coordination in this regard is substantially less – which is a call for the day to take the business ahead.

7.1.4 Production plant vs. transport agency interface

Keeping view to insignificant number of respondents only means are calculated which is depicted in the figure below. It says internal resources, trustworthiness and level of commitment have all nearer means and need to be improved. Forecasting, information collection and dissemination are also found to be having means of 3.05 and 2.60 respectively. Though the hard work is found to be in the field (mean of 3.15), the continuation of the same has got lesser mean (2.65).

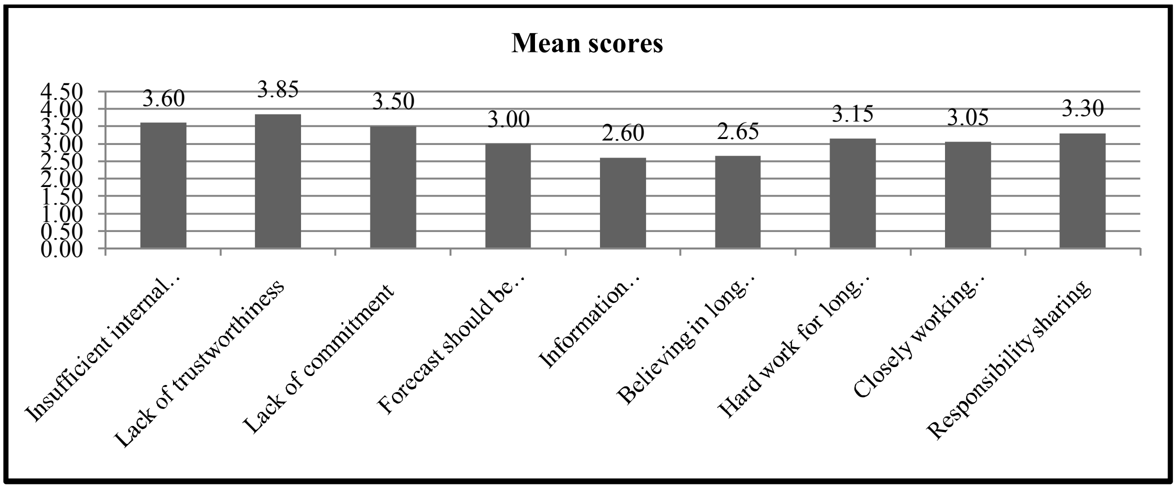


Figure 7.2: Opinions on coordination for PP - TA interface (figures in scale values)

So nobody knows how long the relationship will continue in the supply chain irrespective of their performance. In case of third party logistics providers the tenure of relationship is for three year as per the contract and renewed further to acquire it. Working closely with the production plant has got a mean of 3.05 and the responsibility sharing issue's score is somewhat better to make it to 3.30. It may be stated here that, some of the major responsibilities like transportation, delivery and collection of advances on behalf of the plant is taken care by the transporters. In this way, responsibilities are shared between them, which add value to the coordination process above all.

7.1.5 Production plant vs. retail outlet interface

In the distribution chain, internal resources of the retail outlets also not much sound and hence don't allow the production plant to have proper communications with them. The lack of trustworthiness is found to be opined by only 36 percent of the respondents whereas 38 percent have not made any remark on the issue leaving the rest (27 percent) on the other side of the scale (against the statement).

Table 7.3: Opinions on coordination for PP - RO interface (figures are in percent)

Variables for coordination	Strongly disagree	Disagree	Indifferent	Agree	Strongly agree	Total
Insufficient internal resources	13	13	27	36	11	100
Lack of trustworthiness	3	23	38	24	12	100
Lack of commitment	4	11	49	28	8	100
Forecast should be done and shared	7	10	21	42	20	100
Information collecting and sharing	4	3	17	50	26	100
Believing in long term relationships	5	17	47	18	13	100
Hard work for long term relationships	5	14	42	20	19	100
Closely working with each other	11	25	29	25	10	100
Responsibility sharing	7	28	33	25	7	100

Similar kind of picture is drawn in case of the statement “lack of commitment” where almost half of the retailers don’t have a say in it and putting a question mark on authenticity of the statement. Information collection and dissemination of the same is noticed in case of 76 percent of the cases. Market forecasting is also not in an ordeal, found to be opined by 62 percent of the respondents. According to them, they share their experience and market situations with the plant so that it could be properly monitored and controlled. Long term relationship is found to raise question mark in this interface. Only 31 percent of them has opined in favour of the statement while the 47 percent kept quite. The rest (22 percent) are found to be supporting this and hence a clear-cut inference can’t be made here. The low figure is found to be an outcome of their demand to have more margins and dissatisfaction caused by grant of agencies closer to their business jurisdiction. Hard work, closely working and responsibility sharing are also not much figurative to support the coordination in the interface.

7.2 Multiple – Regression Analysis of Coordination Variables

The variables are brought under the purview of Regression analysis to detect the suitability of the indicators and opinions to the overall model fit to the supply chain coordination process. The indicators are tested according to their overall score (dependent variable) and the variability with respect to their model fit is discussed in the table below.

Table 7.4: Model summary of all interfaces regarding coordination

Interfaces	R	R square	Adjusted R square	Std. error of the estimate	Durbin-Watson
MP – DCS	0.85	0.73	0.72	0.28	2.00
DCS – BMC	0.88	0.78	0.70	0.27	2.10
BMC – PP	0.81	0.65	0.63	0.39	1.98
PP – TA	0.82	0.68	0.68	0.27	1.92
PP – RO	0.76	0.59	0.58	0.36	2.07

It is seen from the table 7.4, the correlation coefficient of the MP - DCS interface is found to be 0.85. The degree of correlation in the DCS - BMC interface is found to be 0.88 whereas it is 0.81 in the next interface in the procurement interface of the supply chain. In case of the PP - RO and PP - TA interfaces the correlations are found to be respectively 0.76 and 0.82. It can be seen that, the independent variables of the supply chain coordination are doing a good job in bringing out the change in the dependent variable (variability).

On an average 70 percent of the variability (R square) can be brought in the dependent variable with the change in the independent variables. More precisely it can be said that, the coordination variables are portraying a clearer picture of the same. Even though the average "adjusted R square" value is slightly lower than the "R square value" still two third of the variability is observed in the dependent variables corresponding to the independent variables.

Since the higher values of "R" and "R square" could raise the issue of a common method bias (CMB), the Durbin-Watson values have been taken into considerations in order to get sure of its non-existence. The Durbin-Watson values for all the interfaces are also depicted which rule out the existence of the auto-correlations in the models (close to zero). More over it is seen from the coefficients of the variables (factors) that no particular variable's coefficient has got a very large value comparing to the other variables. Simultaneously to validate the results, the multi-collinearities are also displayed in all cases which are mentioned in the "tolerance" columns. The more the values in this case are closer to "zero", the higher are the chances for the multi-collinearities. In contrast to this, the variance inflation factors (VIFs) should be lesser than "10" which is the reciprocal of "tolerances" (table follows). The same logic has been applied to all the interfaces and finally the existence of the CMB is fully avoided to make sure that the results are portraying the true picture of the coordination variables.

The combined ANOVA table above depicts of all regression, residual and F – values of the interfaces discussed. It is seen that all the models are statistically significant at five percent level since the "p values" are lesser than 0.05. Moreover the table also indicates that there is a significant difference among the means of the independent variables, which will be displayed hereinafter in the coefficient-table 7.5. The regression values have got on an average of 70 percent of the total value depicted in the "model summary table". In all cases the residual values are substantially lesser than the regression values, which reaffirm the model-fit.

Table 7.5: Combined ANOVA results of all interfaces

Interfaces	Statistics	Sum of squares	df	Mean square	F	Sig.
MP - DCS	Regression	33.96	9.00	3.77	47.78	0.00
	Residual	12.00	152.00	0.08	-	-
	Total	45.96	161.00	-	-	-
DCS - BMC	Regression	6.17	9.00	0.69	9.23	0.00
	Residual	1.71	23.00	0.07	-	-
	Total	7.88	32.00	-	-	-
BMC - PP	Regression	5.33	9.00	0.59	2.11	0.00
	Residual	2.87	10.00	0.29	-	-
	Total	8.20	19.00	-	-	-
PP - TA	Regression	5.97	9.00	0.66	2.34	0.00
	Residual	2.83	10.00	0.28	-	-
	Total	8.80	19.00	-	-	-
PP - RO	Regression	26.59	9.00	2.95	19.81	0.00
	Residual	18.79	126.00	0.15	-	-
	Total	45.38	135.00	-	-	-

The above five interfaces can be further sub-divided into two different categories namely; procurement – production coordination and production – distribution through transportation. Hence in the second phase the transportation part of it appears in the production – distribution coordination. The coefficients for all these categories are being analysed further to make distinctions between statistically significant and insignificant variables. In order to mix the statements with some positive and negative implications, the opinions are taken accordingly to avoid biasness. Since all these are being enquired from the respondents at a time, this is the mandated procedure followed to minimise method bias. The first three factors (arranged later on) are the ones which negatively influence the overall coordination values.

Table 7.6: Procurement – production coordination coefficients

Variables for coordination	MP - DCS		DCS - BMC		BMC - PP	
	Std. coef (β)	Toleran	Std. coef (β)	Toleran	Std. Coef β)	Toleran
Insufficient internal resources	-0.24	0.91	-	-	-0.34	0.57
Lack of trustworthiness	-	-	-0.33	0.61	-0.29	0.61
Lack of commitment	-0.25	0.88	-	-	-0.31	0.62
Forecast should be done and shared	0.29	0.99	0.26	0.84	0.39	0.90
Information collecting and sharing	0.26	0.67	0.34	0.61	0.32	0.72
Believing in long term relationships	0.27	0.93	0.25	0.82	0.27	0.75
Hard work for long term relationships	0.21	0.95	-	-	-	-
Closely working with each other	0.19	0.92	0.32	0.58	-	-
Responsibility sharing	0.31	0.65	0.28	0.63	-	-

If internal resources (like telephone, internet etc.) are not strong enough, then they certainly obstruct the coordination process (communication) and so is the case of "level of commitment and trustworthiness". If any of these lacks the coordination between/among the interfaces troubles a lot. Apart from these statements/variables, all other variables are meaning in positive sense and hence they impact the coordination process positively. The higher the coefficient values in their case the greater are the influences on the depending variable thereto. The blank spaces in the tables show the insignificant coefficients and hence have been removed. In case of the MP – DCS interface, "insufficient internal resources (-0.24), lack of commitment (-0.25) and closely working with each other (0.19)" are major barriers in the coordination process.

All other indicators are working somewhat better comparing to these indicators said above. Since all the tolerance values are far away of the origin (0.00), the scope of multi-collinearity is ruled out. Lack of trustworthiness is found insignificant in this case and is thrown out to being considered further.

In case of DCS – BMC interface, "internal resources and lack of commitment" variables are found insignificant whereas information collection and dissemination (0.34) is working well among significant variables. Relationships with the other chain members (0.25) and forecasting of future events (0.26) are some of the variables need further attention. Here all the tolerance values are also not closer to "zero" indicating the non-existence of the multi-collinearity.

In case of the BMC – PP interface, the last three indicators are insignificant and hence left blank in the table. At this interface, the forecasting (0.39) and information sharing (0.32) are in comfortable position adding value to the coordination process. As said earlier (in On-going practices for BMCs) most of the BMCs are incurring losses, their internal resources (-0.34) are unable to meet the requirement of the production plant. At the same time the trustworthiness (-0.29) and commitment levels (-0.31) are also found to be major drawbacks for the interface-coordination. The levels of tolerances are also found to be higher in this interface eradicating the presence of multi-collinearity.

Table 7.7: Production – distribution coordination coefficients

Variables for coordination	PP - RO		PP - TA	
	Std. coeff (β)	Tolerance	Std. coeff (β)	Tolerance
Insufficient internal resources	-0.22	0.86	-0.31	0.36
Lack of trustworthiness	-0.28	0.86	-0.62	0.55
Lack of commitment	-0.15	0.69	-	-
Forecast should be done and shared	0.15	0.80	0.54	0.49
Information collecting and sharing	0.20	0.68	0.42	0.68
Believing in long term relationships	0.21	0.63	0.32	0.54
Hard work for long term relationships	0.20	0.62	-	-
Closely working with each other	-	-	0.31	0.35
Responsibility sharing	0.18	0.85	0.49	0.50

As mentioned earlier, first three variables in the table 7.7 are barriers to the coordination process and hence have got negative coefficients. Since they are depicted in their negative values (lesser is the crucial), lack of trustworthiness is the major one found at this interface being with the coefficient “-0.28”. There is a greater requirement of the day to have proper knowledge of the market demand by a suitable forecasting mechanism.

At this interface, though it is found to be statically significant still the correlation (0.15) is not a spectacular one and needs further attention. All the tolerances are found to be higher than 0.01, hence the chances of being suffered out of multi-collinearity is ruled out. This is all about, the coordination being maintained in the PP – RO interface. As far as the PP – TA interface is concerned, lack of trustworthiness (-0.62) is major setback to have a proper coordination. In all other cases the values are found contributing to the process and hence the degree of coordination is comparatively better. Here also the chances of multi-collinearity are not found as the tolerance values are more than 0.01.

7.3 Measuring Degree of Supply Chain Coordination

Keeping view to the closeness of the indicators mentioned earlier, six different indicators are concluded.

Table 7.8: Interface – wise degree of coordination

Indicators	MP - DCS	DCS - BMC	BMC - PP	PP - TA	PP - RO	Mean score
Internal resources	1.24	3.00	2.90	1.40	1.81	2.07
Trustworthiness	3.00	1.12	2.10	1.15	1.83	1.84
Commitment	1.24	3.00	2.25	3.00	1.81	2.26
Information sharing	3.76	3.90	3.32	2.80	3.77	3.51
Buyer-supplier relationships	3.35	2.79	3.12	2.83	3.28	3.07
Joint decision making	3.23	3.34	3.00	3.17	2.95	3.14
Component-wise mean scores	2.64	2.86	2.78	2.39	2.58	2.65

Figures mentioned in the table 7.8 portray the mean scores for respective interfaces. It may be noted that, since “insufficient internal resources, lack of trustworthiness and commitment” are the negative statements, their scores have been replaced with the complement values. For instance, if “lack of commitment” achieves a score of “3” then its compliment value is taken to be “2” (5 minus 3). More precisely, if somebody is agreed to a proposal by 40 percent then he/she is disagreed to the same is by 60 percent (compliment of 40). In the above case, forecasting and information colleting & sharing have been clubbed together to have “information sharing”; long term relationships and hard work for the same have been clubbed together to generate a new statement viz. “buyer-supplier relationships”. Responsibility sharing and working closely with each other together pertain a statement of “joint decision making”. In this way six statements (indicators) have been retained to justify the supply chain coordination. Due to less number of factors the factor analysis is not carried out here and hence depending upon the similarity of statements they have been merged with respect to their mean values.

7.3.1 Internal resources

In case of the DCS – BMC and BMC – PP interfaces the internal resources have got relatively better score indicating a better communication in between them. The internal resources could be tangible or intangible assets of the interfaces which are required to have a better communication process. Among the tangibles it could be telephones, internet connectivity etc. and among the intangibles it could be the proper knowledge or expertise to handle all sort of communication-related issues. In this way, the overall score for the same has been retrieved to be 2.07 (41 percent level) in a five point rating scale.

7.3.2 Trustworthiness

It is found that, except at the MP – DCS interface “trustworthiness” is seriously lacking throughout the supply chain. In this case the overall trustworthiness for the entire supply chain is at the level “1.84 (37 percent)” which reveals the faithfulness on each other is seriously lacking. Moreover the stakeholders especially milk producers are not sure whether there will be a positive change in their status in future if they adhere to the system consistently. So generating trust in the system both upstream and downstream are found to be an extremely important factor which has been opined by the stakeholders during the data collection stage.

7.3.3 Commitment

Commitment level is found to little comfortable for DCS – BMC (mean of 3.00) and PP – TA (mean of 3.00) with an average score of 2.26 (45 percent). It is seen to be drastically low at the MP – DCS interface where the score is a mere 1.24 depicting the lack of commitment of the milk producers in production and delivery. It has been already seen that due to non-remunerative price the milk producers are not actually interested in the process which shows the lack of involvement and commitment. The higher commitment shows higher involvement which helps rising the procurement level in the supply chain.

7.3.4 Information sharing

Information sharing seems not to be a problem for the entire supply chain with an overall score of 3.51 (70 percent). Though the level of awareness for the forecasting and intimation of the same to other downstream members has been one of the crucial parts of the coordination process still found not to be very popular as described earlier. It is also seen in some cases that due to lack of trustworthiness, information sharing is obstructed.

7.3.5 Buyer – supplier relationship

Buyer – supplier relationship is found to attain a score of 3.07 (61 percent) indicating that almost in two third of the cases the relationship is maintained and hence is not an immediate threat to the coordination process. But at the PP – TA interface this is to be little more developed to have a better relationship. Since the transport agencies are the third party logistics providers to the federation following a tenure based service, so the long term relationship is not maintained in this interface usually.

7.3.6 Joint decision making

This is another crucial concern for the entire chain to have a proper coordination mechanism. In this case consultations among the interfaces and working together in certain situations seem to be in a better off position with having a score of 3.14 (63 percent). More specifically in two third of the cases this is practiced and in the rest it is not a tradition to be followed. So the scope of this could be enlarged by involving immediate stakeholders in all decision making processes.

7.4 Overall Degree of Coordination

The mean scores for the interfaces and indicators have been mentioned in the above table. At all the interfaces, the degrees of coordination irrespective of the indicators are not very high. The degree of coordination is higher (2.86) in case of DCS – BMC whereas it is slightly lesser in case of BMC – PP (2.76). Irrespective of interfaces and indicators, the degree of coordination is found to be "2.65 (53 percent)". So it can be concluded that the degree of coordination existing in the supply chain is at 53 percent level, indicating a mediocre cohesion among key stakeholders.

7.5 Hypotheses on Supply Chain Coordination

(i) Higher is the trust higher is the level of commitment and better is the buyer-supplier relationship in the supply chain: There is a high degree of correlation found between trust and commitment level (0.80, significant at five percent). In the same way trust also leads to better buyer-supplier relationship (0.85, significant at five percent). So the proposition is accepted at this stage.

(ii) The higher is the degree of supply chain coordination the lower is the risk: At every stage of the supply chain, the risks are discussed along with their impact. In the same way supply chain coordination has been discussed interface-wise by taking two immediate partners confronting each other in their day to day business. Mean risk scores which are calculated in the previous chapter are correlated with the means of coordination at each interface. It is found that there is high degree of negative correlation (-0.69) exits between them ($p < 0.05$). It is inferred that higher is the risk, lower is the coordination and vice-versa. Hence the hypothesis is accepted at five percent level of significance.

7.6 Supply Chain Performance Measurement

Supply chain performance measurement is relatively new and measuring it for the agriculture industry is an extremely difficult task. Further getting direct response from the farmers in this context might be a difficult task in developing countries like India. Unlike foreign countries where corporatisation of agriculture is quite common, farmers or the milk producers in the rural areas of the country do not really understand the business intricacies except the money they earn out of it.

Hence measuring the supply chain performance where they are one of the key respondents is becoming difficult further. In this case efficiency, flexibility, responsiveness, product quality and process quality are broadly followed to measure the supply chain performance in the dairy industry. Even though, it is tried to further simplify the indicators and correlated with the various day to day business functions to make the concept broadened and to get clarity. The idea is to see the indicators to go hand in hand with the demographics and day to day business functions.

Though the broad indicators have been carried forward, still it is not possible to use a common frame for all the components hence “Multiple Regressions” are used to determine the indicators. In case of the production plant (one in number) and the transport agencies (two in number), the same principle have not been in considered and hence their performances are measured (in terms of means) broadly studied from the secondary information and the inputs obtained from the top officials. In all other cases, though opinions have been given priority still, their data relating to cost, time and quality of product/service are also used as yardsticks to get ascertained that opinions relating to performance match with their operational figures. The operational figures vary from component to component but strictly adhering to the cost, time and the quality – the major indicators for any business concern.

Out of the 27 indicators, respectively six and eight indicators are considered for the MPs and DCSs which in turn found to be responsible for 62 and 69 percent of the variability in the performances thereto. Similarly for the BMCs and ROs respectively seven and 10 indicators have been followed to measure their performances. In this case the overall performances are attributed to 80 percent and 71 percent respectively being influenced by the mentioned indicators.

Tables 7.9: Model fitting of performance measures

Components	No. of items	R	R square	Adjusted R square	Std. Error of estimate	Durbin - Watson
MP	06	0.79	0.62	0.62	0.30	1.98
DCS	08	0.82	0.69	0.66	0.19	2.08
BMC	07	0.89	0.80	0.74	0.34	2.10
RO	10	0.84	0.71	0.71	0.13	1.97

On an average 68 percent (Adjusted R square) of the variability in the performances could have been retrieved with the respective indicators mentioned had the performances been measured from the population at large. The “Adjusted R square” values are somewhat refinements of the “R square” values and depict the closeness of the sample estimate w.r.t the population estimate. The lesser is the difference the higher the representation of the sample to the population.

In all the cases the difference between the average representations of “R square and Adjusted R square” is very low and hence it can be said that the variables represent the population with minimum errors. In all the cases the regression values are higher than the residual values and the F-values (table 7.10) are more than one indicating that inaccuracies in the model are substantially lesser than the improvements.

Table 7.10: ANOVA supporting the performance models

Components	Statistics	Sum of squares	df	Mean square	F	Sig.
MP	Regression	146.00	6	24.33	210.17	0.00
	Residual	39.48	341	0.12	-	-
	Total	185.48	347	-	-	-
DCS	Regression	29.42	8	3.68	96.62	0.00
	Residual	5.86	154	0.04	-	-
	Total	35.28	162	-	-	-
BMC	Regression	10.48	7	1.50	13.15	0.00
	Residual	2.62	23	0.11	-	-
	Total	13.10	30	-	-	-
RO	Regression	11.38	10	1.14	70.56	0.00
	Residual	2.23	138	0.02	-	-
	Total	13.60	148	-	-	-

This also depicts that the models give better result than that of the mere mean and hence can be considered further to get the coefficients of the each individual predictors to measure their importance in overall performance. Since the overall performances (dependent variables) are the measures of the independent variables, the chances of biasness could not be ruled out. In order to make sure that the results are out of purview of any biasness the "tolerance values" are depicted against each indicator. The indicator-wise coefficients and their tolerances have been depicted in the table given below.

It can be seen from the table 7.11 that, all the variables are statistically significant ($p < 0.05$) and hence given due weightage for measuring the performance of various components. Some of the sub-indicators are repeating while some are non-repeating. This is due to the fact of different modus operandi of various components. The weightage of each variable can be realised from their coefficients – unstandardised coefficient (B) or standardised coefficient (β). The importance of a variable can be realised from their higher positive values or lower negative values. The coefficients of the indicators are calculated from the multiple regression technique with their tolerance values.

Table 7.11: Indicator-wise coefficients and tolerances

Components	Variables	B	Std. error	β	t	Sig. ($p<0.05$)	Tolerance	VIF
Milk Producers	Constant	0.94	0.10	-	9.21	0.00	-	-
	Facility cost	-0.16	0.02	-0.26	-10.47	0.00	0.84	1.20
	Return on investment	0.18	0.02	0.30	11.59	0.00	0.76	1.31
	Working conditions	0.15	0.01	0.26	11.16	0.00	0.96	1.05
	Delivery flexibility	0.13	0.01	0.24	8.87	0.00	0.69	1.46
	Fill rate	0.15	0.01	0.29	10.97	0.00	0.70	1.43
	Product reliability	0.22	0.02	0.34	14.92	0.00	0.95	1.05
Dairy Cooperative Societies	Constant	1.40	0.10	-	13.81	0.00	-	-
	Facility costs	-0.09	0.01	-0.24	-7.05	0.00	0.95	1.05
	Return on investment	0.07	0.01	0.19	5.39	0.00	0.85	1.18
	Delivery flexibility	0.15	0.01	0.44	11.40	0.00	0.74	1.36
	Fill rate	0.11	0.01	0.30	7.67	0.00	0.69	1.44
	Customer complaints	-0.09	0.01	-0.22	-6.25	0.00	0.85	1.18
	Product safety	0.13	0.01	0.32	9.06	0.00	0.89	1.12
	Storage & transport	0.11	0.01	0.29	8.15	0.00	0.86	1.17
	Working conditions	0.09	0.01	0.26	7.22	0.00	0.84	1.19
Bulk Milk Coolers	Facility costs	-0.19	0.07	-0.30	2.96	0.01	0.83	1.20
	Transportation costs	-0.16	0.05	-0.34	3.28	0.00	0.84	1.20
	Return on investment	0.24	0.09	0.34	2.85	0.01	0.62	1.62
	Fill rate	0.24	0.05	0.51	4.85	0.00	0.79	1.27
	Customer complaints	-0.11	0.05	-0.23	2.14	0.04	0.74	1.35
	Storage & transport	0.14	0.06	0.27	2.47	0.02	0.73	1.37
	Chemical use	0.22	0.06	0.38	3.61	0.00	0.77	1.30
Retail Outlets	Constant	2.01	0.09	-	22.39	0.00	-	-
	Facility cost	-0.10	0.01	-0.48	-11.43	0.00	0.68	1.47
	Return on investment	0.08	0.01	0.21	5.62	0.00	0.89	1.13
	Customer satisfaction	0.05	0.02	0.12	3.03	0.00	0.78	1.28
	Volume flexibility	0.06	0.01	0.22	5.88	0.00	0.82	1.22
	Fill rates	0.07	0.01	0.24	5.89	0.00	0.73	1.37
	Lost sales	0.05	0.01	0.18	4.09	0.00	0.60	1.67
	Customer complaints	-0.10	0.01	-0.37	-9.77	0.00	0.82	1.22
	Promoting sales	0.05	0.01	0.20	4.53	0.00	0.63	1.59
	Display in stores	0.08	0.01	0.34	7.77	0.00	0.63	1.59
	Customer service	0.04	0.01	0.15	3.74	0.00	0.74	1.35

Note: Insignificant variables including constants are not mentioned.

Negative coefficients indicate the indicators impact the overall value negatively; in the sense that, if the value increases the overall value decreases. For instance, the higher is the facility cost, the lesser is the efficiency – which in turn affects the overall performance of the business concern. In contrast to this, the positive coefficients affect the overall performance of the entities in a positive manner. In this way the negative indicators are facility cost, transportation cost and customer complaints whereas the positive indicators are return on investment, customer satisfaction, fill rates etc which add value to the overall performance.

It can be further seen that, all the "tolerance values" are higher than "0.01" hence the ordeal of multi-collinearities have possibly been ruled out. In case of production plant and the transport agencies, the indicators have been taken as per the secondary data and the inputs obtained from the plant/federation authorities. The owners and the officials of the transport agencies have been contacted to gather information in this connection. Keeping view to the less number of responses the idea of using multiple regression techniques have been ruled out and the next best option - mean has been taken into consideration.

7.6.1 Evaluating performance of a milk producer

Evaluating performance of the stakeholders in the supply chain is a difficult task all about. If one can evaluate it for an individual stakeholder the whole supply chain can be measured with the help of both regression coefficients (as weightage of the variable) and the mean responses of an item. For an instance the performance of an individual milk producer has been discussed here elaborately.

7.6.1A: Facility costs (cost of milk production)

Already it has been seen that average cost of milk production is around Rs.14.77 per litre with a minimum and maximum of Rs.5.45 and Rs.20.85 respectively. If someone's cost of production is say Rs.15.00 litre then he is supposed get a score of 3.00 in a five point rating scale. It may be noted here that since the regression coefficient in this case is negative higher value will decrease finally the overall performance. Cost of milk production entangles all types of requirements for rearing cattle and producing milk. It may be noted here that higher cost of production will decrease overall value and hence lower is the better.

7.6.1B: Return on investment

This shows the soundness of the business and is a positive indicator for the performance. Higher is the score for this higher is the overall performance. This depends upon the expertise in this business and cost of milk production and profit. If the cost of milk production is very high then the profit will be low and hence the return on investment will come down. It is calculated that the correlation between the cost of milk production and the ROI is -0.86 which is very high and significant at one percent level. Comparing to the above facility cost the return on investment could be again retrieve a score of 2.00 (cost of milk production is Rs.15.00 litre) since the higher score in this case will be referred to the lower cost of milk production. This also can be taken directly from the profit statement of each individual milk producer or compared in this way.

7.6.1C: Delivery flexibility

This indicates the behaviour of a milk producer towards the delivery according to the requirement of the cooperative societies. If he/she is rigid about something in the delivery process then he will get a lower score in this regard. For an example if a typical milk producer gets a score of 4.00 (highly flexible) then it increases his performance and definitely add value to the supply chain.

7.6.1D: Fill rate

Though there is no target collections from a milk producer still his/her higher pouring capacity is highly valuable for the entire chain which finally increases the level of procurement at the union level. This can be evaluated basing upon the quantum of milk delivered to the society per day. Someone who's cost of milk production is Rs.15.00/lt then his/her pouring capacity will retrieve a score of 3.00. Since higher is the cost; lower is the level of milk production and hence the lower is the fill rate.

7.6.1E: Product reliability

This is a parameter which is very useful for the supply chain. This speaks about the safety and non-adulterating agents in the milk which might spoil the entire milk collection at the society making a huge loss to the union above all. So the society should have a complete faith on the deliverer while receiving milk. It may be noted here that there is no scope to measure the amount of adulteration in the milk at the society level. Some miscreant milk producers add chemicals to enhance the TMS level or make a kind of unnatural milk and add to enhance the quantum. Both cases it won't be value-additive to the performance and hence a positive value is expected out of each delivery.

Let's say a typical milk producer is highly reliable (with no fraud) for his/her produce then he/she is supposed to get a score of 5.00. In 90 percent cases it is seen that the producer-members are reliable and won't do anything mischievous which could be detrimental to the collections of the society. To some extent it also depends upon the working conditions where the milk is produced.

7.6.1F: Working conditions

The quality of milk and non-perishability (clean milk production programme of GOI to say) of milk greatly depend upon the neatness of the environment where the cow is reared for the purpose. Keeping view to an eye to the quality (TMS value) and delivery of fresh and clean milk to the societies the scaling can be done. This has nothing to do with the previous factors discussed. Say in this case the typical score of a milk producer is 4.00 then it shows that the working condition is good. The working condition might not be an important aspect for a milk producer but is vitally important for the overall supply chain performance since the perishability and the sub-optimal quality of milk brings down the profit due to wastage and food values.

Table 7.12: Performance measurement of an individual milk producer

Regression variables	Coefficients (B_i)	Scaling (X_i)	Total score (B_iX_i)
Constant (C)	-	-	0.94
Facility cost	-0.16	3.00	-0.48
Return on investment	0.18	2.00	0.36
Working conditions	0.15	4.00	0.60
Delivery flexibility	0.13	4.00	0.52
Fill rate	0.15	3.00	0.45
Product reliability	0.22	5.00	1.10

The performance of this typical milk producer (Y) = $\sum B_iX_i + C = 3.49$ (scale value)

That is to say that the performance of this milk producer is slightly above the average and can be treated as an asset to the supply chain. Although the ROI is low in his/her case, the other indicator scores are offsetting it and making him/her a valuable supplier of the supply chain. This way the performance of all milk producers can be measured. Since it is not possible to evaluate it one by one, hence the mean response of an attribute can be considered and the regression coefficients can be kept as usual. In an ideal condition, if all the scores are treated to be very high that is 5.00 and the cost of production is very low that is 1.00 (lower the better due to negative regression coefficient) the performance level is also very high nearing 5.00. This depicts the validity of the model without any further discussions on it. So the following discussion will carry it forward to evaluate the overall supply chain performance by this rule.

7.7 Evaluating Performance of Supply Chain

There are 27 supply chain sub-indicators discussed in the table given below. The indicators are chosen broadly from the factors like efficiency, flexibility, responsiveness, product quality and process quality. The component-wise mean for each indicator has been mentioned along with the overall supply chain scores for a comparison thereto. It may be noted here that, higher mean scores refer to better performance in the respective indicators. The means are calculated by keeping view to the profit centric or cost centric approach of the respective parameters.

For an instance, cost related indicators are the negative statements, which needs further investment in the supply chain. No matter whether a statement is positive or negative, the opinions have been collected how efficiently they are managed. The values of some of the profit/cost centric statements are further tallied with the figures calculated from the secondary data collected to bring a contrast in this respect. The below given table depicts the mean scores for the parameters along with their coefficients of regression.

7.7.1 Efficiency

Comparing the efficiency factor it can be seen that the retail outlets are the best performers which could be attributed to the low investment and high profit at their level followed by the dairy cooperative societies' and the milk producers' performances. They are slightly above the average level wherein the production plant and the transport agencies follow them. Bulk milk coolers' performance in this context is drastically low which is attributed to higher transportation costs (both inbound and outbound) and low ROI. The detailed descriptions are already mentioned in the analysis section of the study. The overall performance of the dairy food supply chain from the view of efficiency considerations is an average one (2.60) and needs to be improved further (tables 7.13 and 7.13A).

Table 7.13: Sub-indicator wise supply chain performance measurement (figures are in scale values)

Statistics		Milk producer			Dairy coop society			Bulk milk cooler			Plant	Transport	Retail outlet		
		B_i	X_i	B_iX_i	B_i	X_i	B_iX_i	B_i	X_i	B_iX_i	Mean	Mean	B_i	X_i	B_iX_i
Constant		0.94	---	0.94	1.40	---	1.40	---	---	---	---	---	2.01	---	2.01
Efficiency	Facility cost	-0.16	3.15	-0.50	-0.09	3.34	-0.30	-0.19	1.51	-0.29	1.45	2.55	-0.10	3.00	-0.30
	Transportation cost	---	---	---	---	---	---	-0.16	2.06	-0.33	3.80	3.25	---	---	---
	Inventory cost	---	---	---	---	---	---	---	---	---	1.45	---	---	---	---
	Return on investment	0.18	2.78	0.50	0.07	2.95	0.21	0.24	2.97	0.71	2.90	2.35	0.08	3.26	0.26
Flexibility	Customer satisfaction	---	---	---	---	---	---	---	---	---	3.85	3.95	0.05	3.85	0.19
	Delivery flexibility	0.13	3.14	0.41	0.15	3.19	0.48	---	---	---	3.70	3.90	---	---	---
	Volume flexibility	---	---	---	---	---	---	---	---	---	4.45	3.45	0.06	3.19	0.19
	Back order	---	---	---	---	---	---	---	---	---	3.65	---	---	---	---
	Lost sales	---	---	---	---	---	---	---	---	---	3.15	---	0.05	2.55	0.13
Responsi-veness	Fill rates	0.15	2.51	0.38	0.11	3.17	0.35	0.24	3.18	0.76	4.60	---	0.07	2.97	0.21
	Lead time	---	---	---	---	---	---	---	---	---	2.05	---	---	---	---
	Customer response time	---	---	---	---	---	---	---	---	---	4.20	3.60	---	---	---
	Customer complaints	---	---	---	-0.09	3.16	-0.28	-0.11	1.82	-0.20	1.26	3.00	-0.10	2.58	-0.26
Product quality	Product appearance	---	---	---	---	---	---	---	---	---	3.85	---	---	---	---
	Product taste	---	---	---	---	---	---	---	---	---	4.15	---	---	---	---
	Product shelf life	---	---	---	---	---	---	---	---	---	3.70	3.25	---	---	---
	Product safety	0.22	3.81	0.84	0.13	3.80	0.49	---	---	---	4.50	2.50	---	---	---
	Product reliability	---	---	---	---	---	---	---	---	---	4.55	3.15	---	---	---
Process quality	Traceability	---	---	---	---	---	---	---	---	---	4.29	3.35	---	---	---
	Storage & transport condit.	---	---	---	0.11	3.54	0.39	0.14	4.47	0.63	4.68	3.40	---	---	---
	Working condition	0.15	3.45	0.52	0.09	3.22	0.29	---	---	---	3.70	---	---	---	---
	Chemical use	---	---	---	---	---	---	0.22	3.85	0.85	3.15	---	---	---	---
	Energy use	---	---	---	---	---	---	---	---	---	3.95	---	---	---	---
	Sales promotion	---	---	---	---	---	---	---	---	---	3.45	---	0.05	3.31	0.17
	Store display	---	---	---	---	---	---	---	---	---	---	---	0.08	3.12	0.25
	Customer service	---	---	---	---	---	---	---	---	---	3.80	---	0.04	3.11	0.12
Total		---	---	3.08	---	---	3.02	---	---	2.13	3.55	3.21	---	---	2.97

Table 7.13A: Indicator wise performance measurement of various components

Indicators	MP	DCS	BMC	PP	TA	RO	Means	Inference
Efficiency	2.80	2.85	1.64	2.56	2.72	3.01	2.60	Average
Flexibility	2.66	2.88	2.39	4.12	3.77	3.02	3.14	Average
Responsiveness	2.37	2.86	1.37	2.63	3.30	2.48	2.50	Poor
Product quality	3.60	3.44	---	4.25	2.97	---	3.57	Good
Process quality	3.26	3.06	3.13	4.21	3.38	3.05	3.35	Average

7.7.2 Flexibility

It is the indicator which shows the organisation's adaptability to meet change its production or delivery processes to maximise profit and customer satisfaction. The procurement chain seems to be out of purview of the flexibility which is not at all a good indication. Most of the variables in this case are found to be either insignificant or opined as not applicable wherever it is strongly felt that some of these variables are of great importance to the supply chain. The overall score for the flexibility is calculated to be 3.14 (average) wherein volume flexibility, back order and the lost sales' performances are below this score and in return responsible for lower performance in this connection. The bulk milk coolers are at the lower level and hence the overall flexibility performance has come down. Milk producers too need to improve in the volume of production which at the subsequent phases lowers down the level of procurement.

7.7.3 Responsiveness

The low responsiveness could be due to the lower fill rate across the supply chain. The lead time for the production plant is almost 24 hours, wherein the raw milk is procured from the chilling centres and processed to manufacture various products. Since the supply chain deals with the perishable material, it has to be agile to curb damage and retain its food values. The production plant is found to be less agile to respond to the customers (retailers), which ultimately decreases the overall performance of the supply chain in this regard. Customer complaints, in case of the retail outlets are the highest and lowest in case of the production plant. Retail outlets sometimes deliver damaged and leaked products to the customers and demand more money than the maximum retail price on the pretext of refrigeration. This factor sometimes leads to customer dissatisfaction and finally they complain about the issues.

While comparing the overall figure it is found that the chilling centres are performing at a sub-optimal level. The higher customer complaints in their case are due to the variations in "total milk solid" content, as claimed by the reception desk of the plant. Total milk solid (fat and protein) content of the milk is found to be lesser at the reception counter of the plant comparing to the figures provided by the chilling centres. Many a times, this leads to altercations and impose of penalty by the plant authorities thereto brings discontentment among the chilling centre officials. The overall responsiveness of the supply chain is found to be 2.50 (poor) which require further attention of the stakeholders.

7.7.4 Product quality

As it is seen from the table 7.13A that, the product quality is maintained throughout the supply chain which in return giving rise to a score of 3.57 (good). It has been experienced that, due care is being taken for the safety of milk even at the dairy farmers' sheds and seem to be maintained throughout the chain to bring a satisfactory performance in this regard. Product safety and reliability part of supply chain are found to have higher ratings spreading a message of higher performance almost at all stages. The shelf life of the product needs to be improved in the supply chain to make it more fresh and suitable for consumption. Especially the production plant should be more proactive and taking necessary actions in this connection. But it is found that the product quality is not at par with the price and hence the mismatch or incompatibility leads to discontentment among the customer where the supply chain has to improve.

7.7.5 Process quality

In this case the performance of the supply chain is also an average one and is found to be uniform across all the stages. The satisfactory score in this case is due to the proper storage and transporting conditions in the procurement chain and efficient energy and chemical usage further add value to the overall process. Traceability, today due to the advent of sophisticated information tools, performs much better than ever before. All these parameters are aggregating to a higher level of performance by making it to the level of 3.35 for process quality.

7.7.6 Component-wise performance

The above figure depicts the component-wise performance of the supply chain. It is seen that the performance of the procurement chain is inferior to the distribution chain. The least performance is seen from the bulk milk cooler (2.13) side on behalf of the union which in turn reducing the overall procurement performance of the supply chain. Production plant has the best possible score of more than 3.00 followed by the transporting agencies and the retail outlets. The production plant is really performing better than all other stakeholders in the system which is supposed to bring attention in the supply chain to further improve their performances.

The overall score of the supply chain irrespective of all components and indicators is calculated to be 3.03 – depicting an average performance.

7.8 Supply Chain Performance Based on Indicators, Risks & Customer Satisfaction

Excluding the indicators, there are two other important dimensions added to this study, namely; customers' views on products/services of the federation and the risk coping efficiency (non-impact of the risks) of the stakeholders in the supply chain. The component-wise risk coping scores and the customers' rating of the products and services of the chain have been cited in the below given table. This evaluation is based on the presumption that the risk coping is the efficiency of a stakeholder to control/minimise the risks.

This is treated to be the non-impact of the risks and hence taken as a compliment to the risk impact in the sense that risk-impact and risk non-impact make it to 100 percent. Here it is calculated from the scale value after deducting it from the risk impact. For an instance if someone's risk impact is 3.00 then in his/her case the non-impact will be 2.00 (5.00-3.00). May this non-impact could be because of several other reasons but one possible reason could be the stakeholder's risk management approach (to be put as one of the issues in future research segment).

After considering the risk coping efficiency of the stakeholders it is seen that the procurement chain does not have any change while production plant and retail outlet performances are degraded. Transporting agencies do not find any change after due considerations to their risk coping efficiencies. Though qualitatively the performance does not change still quantitatively the change is significant. Categorically it can be seen from the table that the supply chain performance comes down by 14 percent after considering the risk factor. When it has been found that risks and uncertainties can't be ruled out the supply chain, then the risk coping efficiency of the various components are included further to get a clearer picture in the performance issues.

Table 7.14: Supply chain performance summary

Components	Indicator score	Risk coping	Mean	Inference
Milk producers	3.08	2.20	2.64	Average
Dairy cooperative societies	3.02	2.34	2.68	Average
Bulk milk coolers	2.13	2.10	2.12	Poor
Production plant	3.55	1.78	2.67	Good
Transport agencies	3.21	2.37	2.79	Average
Retail outlets	2.97	3.02	3.00	Poor
Supply chain performance	3.07	2.30	2.65*	Average

*performance is decreased by 14 percent

The risk coping efficiency of the supply chain is found to be "poor" indicating that attention to this respect should be given priority by all stakeholders. The details of the risks and uncertainties have been discussed earlier in the risk identification and assessment sections. It is found that the correlation between the supply chain performance and risk coping efficiency of the partners is around 0.71 (significant at five percent level). So higher is the risk coping efficiency higher is the performance since the supply chain performs better if lower risks are there on its way.

Now together with the customer satisfaction the performance level goes up to 3.15 score – a little better score than before. Finally the supply chain is performing at an average rate based on the various operational indicators, risk coping efficiency and customer satisfaction index.

7.9 Hypotheses for Supply Chain Performance

In this case the hypotheses are tested for all the stakeholders. The results are interpreted in the following ways:

(i) There is a difference in the performance level of stakeholders: All the stakeholders in the system are working at the same level (mean scores) excepting the production plant.

So logically there is no significant difference in their level of performance. Hence all the stakeholders should perform accordingly to enhance the level of the supply chain.

(ii) Supply chain performance is positively influenced by the risk coping efficiency of the stakeholders: It is seen from table 7.14 that, the supply chain performance with risk coping, is reduced by 14 percent ($p<0.05$). Had it been higher, the performance score have been higher. Hence “higher is the risk coping higher is the performance.”

7.10 Conclusion

The dairy-food supply chain is operating at an average level. This performance measurement identifies the areas where the supply chain should focus on. Though, risk coping efficiency of the stakeholders found to have significant effect on the performance of the supply chain still there is little attention given to the same. Today, supply chain performance measurement is gaining its momentum across industries to identify the industry’s stand in the market place. This reportedly speaks of the vulnerable areas in the chain irrespective of its stakeholders. The item-wise as well as the component-wise performance detection in the supply chain caution the organisations to take care of certain issues and to get proper alignment among its supply chain partners. The performance measurement of the supply chains will definitely create new avenues for further improvement of itself and its stakeholders.

CHAPTER VIII

SUMMARY AND CONCLUSION

The present chapter portrays the summary of findings starting from the level of milk producers to the customers of the supply chain along with necessary recommendations to improve the sector. It may be noted here that most of the variables (representing a component) are treated from a supply chain perspective and hence efforts are made to correlate them with cost, profit and stakeholders' satisfaction.

8.1 Milk Producers as Suppliers

In this research, necessary care has been taken to analyse the profitability of the stakeholders participating in the supply chain. Milk producers are the suppliers of the dairy food supply chain so without their participation the dairy industry will come to a standstill position.

8.1.1 Man-woman participation in dairy farming

Dairy farming as a profession basically practiced in the rural and suburban areas in anticipation of extra earnings during leisure time and getting access to consumption of milk as well. Even though both man and woman participate in the process, it is the man who dominates woman in the process. It is observed that man-woman ratio in the profession is 58:42 in the state of Orissa while it is 72:28 in the country. The trend is increasing both at the state and the national level to encourage woman participation so that while man can go out for the agriculture related activities woman of the family can take care of the cattle and help the family to earn more. It may be noted here that the state of Orissa is on the top of the man-woman participation list in the country followed by Tamil Nadu and Himachal Pradesh.

8.1.2 Main vs. subsidiary occupations

Agriculture or cultivation together with dairy farming is the most sought after profession (more than two third cases) found in the rural areas at the grass root level. But due to marginal land and low cattle holding (with one or two cattle), the earnings from the sources do not contribute much to their income and standard of living. Also the common matter of fact "higher the land holding higher the cattle holding" is proved to be wrong at this stage. As a repercussion of small cattle size milk production is found to be drastically lower and not to be contributing to profit and income. It has been seen that below 16 litres of milk production per day (with no more than two cows) there is no scope for profit irrespective of professions. Almost in two third of the cases negative profit and hence a negative ROI is detected.

8.1.3 Participation at the societies

Dairy cooperative societies are set up within the approachable distance from the milk producers' houses so that the collection of milk would be easier and perishability can be minimised. In the study two third of the milk producers' houses are found situated within the radius of one km from the societies and hence "walking" is detected to be a preferred mode of conveyance.

As long as the milk producers' participations with the cooperatives are concerned it is found that, initially the milk producers try to sell their produce at the nearby markets but due to excessive competition in the unorganised market and lack of accessibility to these markets, they ultimately participate in the society by taking its membership. This comes as a fact when it is found that the average year of experience in dairy farming of a milk producer is more than the average year of time spent in the society. But in one third of the cases it is found that due to inaccessibility or unavailability of society in a particular locality, milk producers are compelled to look for other alternatives to sell their produce.

8.1.4 Driving forces of society participation

Among the members, two different categories are observed namely pouring and non-pouring. The pouring members are those who are selling their produce on regular basis where the non-pouring members are just members on the roll. This is due to the anticipated benefits from the supply chain drags them to join these societies but when remains unfulfilled they quit in a guised way – with an average attrition rate of 40 percent. On the other hand the non-remunerative milk price is found to be responsible for higher attrition rate. However availability of fodder at reasonable price (27 percent variability), hassle free sales (17 percent variability) and empowerment through education (13 percent variability) are the major driving forces observed behind someone's participation at the dairy cooperative society.

8.1.5 Milk production and seasonal variations

The mean milk production capacity of the cows fluctuates with the periods namely flush season and lean season. The flush seasons starts in the month of September and continues till February and lean season starts at March and ends in August. It has been experienced that, on an average flush season milk production capacity of cows is 30 percent higher than the lean season. During the flush season there is a scope for the cows to get green fodder which subsequently decreases with the onset of summer (dry period). The production is also found to be affected by the cow's calving. As the cows come closer to their calving the yielding decreases and increases further after the calf is born.

8.1.6 Range of milk production

The production ranges from 1.5 litres to as high as 100 litres per day depending upon the capacity of the milk producers. The higher milk production is from the bigger farms with having seven or more high yielding cows at their disposal. It is found that 80 percent of the producers produce "less than 18 litres" of milk per day (both morning and evening shifts) with an average of 13.6 litres. The milk production per cow per day found to be ranging from 1.5 to 26.3 litres (3 sigma level) with an average of seven litres.

8.1.7 Factors affecting level of milk production

This is already verified that the milk production level varies linearly with the expenditure incurred on the feed and fodder. But due to low financial background, two third of the milk producers are striving it hard to feed their cattle which ultimately reducing their production level. Though it is slightly an expensive affair to rear high yielding cows (e.g. jersey cows) still more than two third of the milk producers have owned at least one jersey cow in their shed and are able to produce more than four litres of milk per day. It is seen that due to upkeeping of the indigenous cows the average milk production level comes down. Even though people know that the indigenous cows are low yielding still they rear them for the sake of spiritual reasons and perceive that food values of this category milk is higher than other category cows.

8.1.8 Quality of milk produced

Quality of milk varies with the fat and SNF (solid-not-fat) concentration in it and is termed to be the total milk solids (TMS). If one of the components goes down the quality level decreases and the price of milk also comes down bringing loss to the milk producers. The average TMS level is found to be 12.0 percent ranging from 11.1 to 15.3 percent. The federation these days is deducting milk price proportionately upon not meeting the prescribed TMS level of 12.5. The quality is much dependent upon the cattle species e.g.

the TMS level of jersey cows is higher than the indigenous cows and crossbred cows. The expenses on fodder and medicines also are found to be an influencing factor for the quality of milk produced.

8.1.9 Factors of cost of milk production

The cost of milk production depends upon various factors namely infrastructure, equipments as fixed cost items upon which the depreciation is calculated. Under the variable-cost category feed and fodder, medicine and concentrate, labour etc. are taken into consideration for calculating the cost of production.

It is observed that more than half of the cost is incurred for the feed and fodder, another quarter is incurred for the health and medicines. Labour is comparatively cheaper in the rural areas and hence the investment for the factor is low. In most of the cases it is seen that, dairying is a subsidiary profession where people devote their spare time for milk production and hence imposing of outside labour for this activity is found in farms with more than five cows. Since labour cost is one of the major factors of milk production hence it has been given due weightage in the list of factors even though milk producers opine it to be their spare time job. It is seen that the cost of milk production decreases with the increase in milk production up to a certain level and increases further.

8.1.10 Cost of milk production

Neglecting the outliers of the cost of milk production the minimum of it is found to be Rs.10/lt where the level of milk production is 50 litres per day. Otherwise the cost of production is varying from Rs.5.45 to Rs.20.85 per litre depending upon the level of milk production. The mean cost of production is evaluated to be Rs.14.77 per litre where almost 60 percent of the milk producers’ costs of production are found to be falling in the range of Rs.9.30 to Rs.17.

8.1.11 Variables affecting cost of milk production

Again at a constant milk production level, increase in the cattle size will substantially increase the cost of production. It is seen that at 50 litres level of production, with the help of two jersey cows, cost of milk is found to be Rs.10/lt whereas addition of one more cows increases the cost up to Rs.15/lt (50 percent). In this way the cost of production will decrease if the average milk production per cow per day increases. There could be several other combinatorial factors but level of milk production and fodder are the most vital factors as they substantially influence the cost of milk production. One unit of increase in these variables will respectively decrease and increase the cost of milk production by Rs.1.40 per litre (almost 10 percent) and one unit (same percent of feed and fodder cost) subject to same infrastructural conditions.

Quality of milk (TMS level) also has an indirect effect on the cost of milk production as it gives more profit to the producers. Moreover rearing of buffaloes in the system increases the TMS level and hence higher profit can be earned. This is due to the fact that buffaloes do not need any extra care and hence rearing more buffaloes in the shed gives the more benefit. But this is opposite in case of cows, as extra expenditure has to be incurred on their feeds, health and medicines which more than offsets the costs without giving any additional advantage to the milk producers.

Apart from the level of milk production and various costs; demographic factors like age, gender, land holding, cattle holding and experience in dairy farming are found not to have any significant impact on the cost of milk production. Even the landholding which compensates the cost of feed and fodder has got a low correlation (0.10) with the cost of milk production. It also refutes of the higher correlation between the landholding and cattle size – in the sense that those with higher lands may not necessarily have opted dairying as a subsidiary profession and reared more cattle and vice versa.

8.1.12 Household milk consumption and sales

Though there is an increasing awareness among the consumers for milk consumption still due to low per capita income and income of the family as a whole, affordability for the same is found not to be possible in many cases. Indirectly it is the landholding which decides the income of the milk producers' families and found to be an influencing factor for the milk consumption. On an average 0.5 to 2.5 litres of milk per day is kept for the household consumption depending upon the rate of production and family size.

There is a difference noticed in the sales and surplus milk at the households of the producers. As the milk producers are the members of the dairy cooperative societies, they are supposed to sell the surplus milk entirely to them but deviations are detected in some cases which indicate existence of informal selling. This is due to the non-remunerative milk price at the DCSs makes them demotivated to sell their produce entirely. Some of the milk producers even do not bring their surplus milk at all for which over a period of time societies comes to defunct stage if practiced on a large scale.

8.1.13 Profit and ROI

It is detected that cost of milk production in the range of "Rs.5.45 to Rs.9.30" (almost one third) the profit and ROI are positive. This is found in some places where there is a scope for the green pastures and landholding in case of a milk producer to some extent. But proper feeding with the fodder and concentrate is rarely detected in the range. The mean profit of all the producers is found to be negative whereas the profit "without the labour cost" is somewhat positive and not very lucrative too. In almost two third cases the profits are negative and so is the return on investment. Another 22 percent of milk producers make a profit of less than Rs.1,500 per month. But if the profession is treated to be a part time affair and labour cost is not taken into consideration then the profit is slightly improved and negative profit is found to be in 22 percent of the cases.

On an average the loss per litre is found to be Re.1 in the sense that if the cost of production is Rs.14.77 per litre then the sales price is coming to be around Rs.13.77 litre with a TMS level of 12.5 percent. The sales price of milk on meeting the stipulated quality standards (TMS of 12.5 percent) is Rs.13.76 per litre as is fixed by the federation.

8.1.14 Variables affecting profit and ROI

The ROI is negative indicating the lack of profitability of dairy farming as a whole. The cost of milk production in most of the cases is found to be higher than that of the selling price at the cooperative societies. The quantity of milk production is another barometer which decides the profit level and the return on investment. It has been observed that the profession is profitable if the minimum level of milk production is about 16 litres per day supported with two cattle.

Penalty on the milk is charged when the minimum TMS level is lesser than 12.5 percent. In almost two third cases the TMS level is found to be 12 (mode) which is found to be subjected to penalty. This penalty system reduces the sales, profit and ROI and leads to discontentment among the milk producers. Further the high cost of milk production brings down the profit and subsequently reduces the return on investment. It is inferred that due to higher cost of production, non-remunerative price and penalty on low TMS, the profit and ROI are becoming low and leading to discontentment among the milk producers and making them demotivated towards dairy farming above all.

8.1.15 Level of satisfaction being with the supply chain

Since the milk producers are the suppliers of the supply chain, it is highly essential to know their overall satisfaction and level of commitment to make it more competitive. Managing costs of milk production, improving risk coping efficiency and overall performance are all found ending up with negative results. The milk producers' are not much benefitting from the supply chain. On the contrary the level of satisfaction is found to be an average one (3.19 score on scale) which could be attributed to the satisfactions derived from the factors like hassle free sale and regular payment (input provider) of the system. So it is inferred that joining and remaining in the supply chain for a long time may not necessarily be a value addition for the milk producers unless due price is given them for their produce.

8.2 Dairy Cooperative Societies

Dairy cooperative society (DCS) collects milk from their members twice a day and send it to the specified bulk milk cooler (BMC) through the head loader. The head loader not only carries the collected milk to the BMC rather help the secretary of the DCS in disbursing other activities too.

8.2.1 DCS organisation and membership

It is observed that only one in every four milk producers in the rural areas is associated with the society which shows the inefficiency of societies to organise milk producers into the supply chain. There are villages found with all milk producers as members of the concerned societies while in some other cases the participation is as low as four percent. Out of the average memberships at these organisations, the women play a dominant role with more than 50 percent of the memberships. Again among the enrolled members two categories are detected viz. pouring and non-pouring which is already discussed in the milk producer segment. Respectively 42 percent and 43 percent of the DCSs are found to be operating with "less than 50" and "50-100" members whereas only in 16 percent cases membership base is seen to be more than 100. The average membership found in a typical DCS is around 70 and is going up to the level of 250.

8.2.2 Reason behind DCS formulation

It is observed that high marketable surplus of milk in a particular area is the major driver of DCS formulation whereas the union initiative comes next as an effort. Rests of them have been set up with an intention of getting self employment and is found to be an initiative of unemployed locals. Almost two third of the functional DCSs are found to be registered as per cooperative guidelines whereas the rest are not registered but functioning at par with the registered DCS.

8.2.3 Years of operation and coverage area of a DCS

While some of the DCSs are quite new, some are as old as more than 20 years covering a minimum of three revenue villages with an area of 6.4 sq km. The area of coverage is found to be ranging from 0.5 sq km to as high as 45 sq kms with a maximum distance of 29 kms from a BMC. It is seen that some of the DCSs are recently converted to BMCs due to higher influx of milk and hence in the same place both DCS and BMC operate.

8.2.4 Member -waiting time for delivery

The waiting time of the members on the queue to deliver their produce depends upon the total pouring members of the society present on a given point of time. Thus higher are the pouring members the more will be the average waiting time of a member to deliver. It is quite relative and found to be varying from society to society. It is seen that in few places people are waiting for more than 20 minutes while at some of the societies within two minutes they are served. Today the automated milk collection units (AMCUs) at the society level also reduces substantially the waiting time of the milk producers but is yet to be implemented in the state. In this respect Gujarat is much ahead and is an ideal case for all dairy federations.

8.2.5 Milk collection – quantity vs. quality

The collections of milk during lean seasons are seen to lesser by 30-40 percent comparing to the flush seasons. The average society milk collections in flush and lean seasons respectively are found to be 139 and 88 litres per day, with a mean of 113 litres per day (taken flush and lean together). The minimum and maximum collections are found to be respectively varying widely over “5 to 490” litres per day indicating a high degree of dispersion in milk collection. In some of the cases, though not binding, a target is fixed by the supervisors of the union in milk collection. In that case, the fill rates (actual/target) are varying from 30 percent to 175 percent with a mean of 78 percent. The average TMS level of these societies is found to be varying between 10.6 and 15.4 percent indicating impose of penalty in certain cases.

8.2.6 Factors affecting level of milk collection

In order to determine the factors behind the level of milk collection some of the respondents' profile and field characteristics have been considered. Educational background of the secretary or supervisor, producers' participation with delivery and the pouring members' contribution to the milk pool are found to be positively affecting the level of collection. On the other hand mere participation of the milk producers in the system, irrespective of the reasons, is found to have no/negative impact on the level of collection. Though it is supposed to hike the collection still the low pouring memberships due to the disloyal nature of some members and/or non-remunerative price of milk are observed to be major impediments. It is as good as not to have the rest of the members since they do not contribute to the system.

It is found that higher pouring memberships adding value to the collection irrespective of individual member's pouring capacity. Each additional committed member will increase at least 1.5 litre of milk collection per day which is an average collection from a member detected in almost half of the cases. Excepting these variables other variables like age of the secretary, registration status of the society, reason behind the society formulation, operational area of the society etc. do not have substantial contribution to the milk collections though they are supposed to contribute to the process.

8.2.7 Average delivery of a producer-member

It is seen that the milk producers in the states of Gujarat, Rajasthan, Punjab and Orissa are delivering respectively 3.07, 2.44, 2.39 and 1.69 litres of milk per day to the dairy cooperative societies as against national average of 1.81 litres. The small quantity of milk when procured from millions of farmers, though meeting the of requirements the dairy federations but not improving the standard of a typical milk producer who owns just "one to two" indigenous or crossbred cattle at his house. The issue here is not just to rear cattle for the sake of consuming milk and selling the surplus to the society rather it has been considered from a supply chain view point where cost and profit are the prime concern.

8.2.8 Cost price of milk

Excluding the cost of collection, the cost price of milk at this stage is varying from Rs.11.23 to 17.12 with a mean of Rs.13.69 per litre, which is being paid to a member producer upon delivery. The fluctuation in cost of milk is found to be Rs.0.80 per litre which depicts that, almost all DCSs' payment is varying from Rs.11.29 to Rs.16.09 per litre (3 sigma levels).

8.2.9 "Factors and cost" of milk collection

Keeping view to the average milk collections and the TMS level, the cost of collection has been calculated. The DCSs expend very little towards their day to day activities pertaining to house rent, electricity charges, sanitary wares etc. Almost all the societies operate in the rented houses out of which only five percent of them have got artificial insemination facilities (AI). Including the electricity and other charges a mean expenditure at this level has been found to be Rs.350 per month irrespective of the collections. It may be cited here that there is a low degree of correlation found between the level of collection and the expenses incurred. Only seven percent variability in the monthly expenses is found to be attributed to the average milk collections.

The mean cost of collection is calculated to be Rs.0.21 per litre irrespective of all expenses. Initially the cost of collection is very high where the level of collection is less than 50 litres per day. Gradually with the increase in the level of collection, the cost comes down and remains stagnant afterwards. A close look at the cost vs. level of collection curve ensures the trend to have ended with the collection of 100 litres per day beyond which the level of collection does not have any effect on the cost of collection. Other kinds of costs e.g. secretary commission, remuneration for the head loader etc. is borne by the union and hence societies do not have to expend anything in this regard.

8.2.10 Sales and receipts

It may be noted here that the DCS collects milk from the members in terms of litres whereas sales are made in terms of kgs. So the litre-kg variation gives additional profit to the society and is a source of earning. Due to higher specific gravity of milk it is heavier than water and weighs three percent more in mass.

The sales turnover of a DCS, on an average, is found to be 3,512 kgs per month with a standard deviation of 2,901 kgs. It is seen that around half of the DCSs collect less than

100 litres of milk per day in both the shifts (morning and evening) with a mean shift collection of 50 litres. Considering the collections, fat and SNF price and sample collection (10 ml of milk collected separately as sample for detecting the TMS level from each milk producer) the sales turnover are calculated. The minimum and maximum sales turnovers are Rs.2,419 and Rs.208,910 respectively, where more than half of the DCSs have a mean sales turnover of Rs.49,534 per month. In some cases, the net receipts are calculated after a due deduction as penalty upon not meeting the prescribed TMS level. It has been seen that almost half of the DCSs are not meeting the specifications and liable to pay penalty thereto. Many a time, they complain that, the specified TMS level is an ideal case and in order to achieve the same high yielding cows need to be reared and is an expensive affair for most of the members.

8.2.11 Profit and ROI

It is seen detected that the sales price at this stage is varying from Rs.11.74 to Rs.17.93 with a mean of Rs.14.34 per litre after due deductions. The minimum and maximum profits per litre of milk are seen to be Rs.0.51 and Rs.0.81 respectively, with an average of Rs.0.64. The total profit at this level is the profit made from sales of milk as well as sale of fodder and medicines, which is usually provided to the members at a subsidised rate. The profit made from the fodder and medicines is quite nominal and is in interest of the members. The total profit is found varying between Rs.119 to Rs.12,222 per month depending upon the level of collections. The net profit after all operational costs per month is again found to be varying between Rs.-372 to 11,422 which is slightly lesser than the profit before meeting the monthly expenses with an average of Rs.2,500.

As is said previously only a few DCSs operate in their own houses while others operate in the rented houses with a mean asset level of Rs.56,262 including the Milko Tester. The Milko Tester is usually provided by the union to the DCSs on credit and is recovered from them over a period of time on instalment basis. This particular cost is not taken for consideration here since most of the cases the amount accrued are found to have been recovered. Since the DCSs are operating with comparatively lower investments, there is a higher scope for them to earn profit and make their ROI as positive (mean of 70 percent). It is seen that, only five percent of the DCSs have a negative profit, thus making them to have a negative return over their investments.

8.3 Bulk Milk Coolers

BMCs or the chilling centres chill the milk collected from the DCSs, at around 4^0C temperature and subsequently send it to the production plant for further processing. Once in a day, the milk is collected by the tankers from the respective BMCs as per the route assigned to them. The tankers are maintained at around 25^0C -30^0C temperature in order to transport the content without damage till the production plants.

8.3.1 Infrastructural status and processing capacity

Keeping view to the marketable surplus of milk in a particular area the BMCs are set up by the union/federation by getting funds from central, state or non-government agencies. The funding agencies finance the union for purchasing machineries and equipments whereas the federation provides land and building in most of the cases for a BMC to be set up. Two third of the BMCs are found to have their own infrastructure whereas another one third of them are found depending upon the rented houses for their day to day operation. On an average one fourth of the total expenditure is incurred for the required building whereas the rest is expended for the machineries.

8.3.2 BMC operational area

The minimum and maximum distances of the BMCs are found to be respectively 25 and 125 kms with a mean distance of 71 kms from the production plant. The BMCs are found operating with an average area of 75 sq kms and DCS base of 11. The DCSs are generally found in the interior of the rural areas whereas the BMCs are seen in the urban or semi-urban areas with proper road connectivity. The average distance of a BMC from the DCSs is around seven kms with a minimum and maximum distance of 2.5 and 13 kms respectively. It is also seen that the average number of milk producing members under a particular BMC to be 557 with a minimum and maximum of 55 and 1,700 respectively.

8.3.3 Procurement of milk and capacity utilisation

The average collection and chilling is found to be around 800 litres (824 kgs) per day at a typical BMC. As a whole the unions through these 33 chilling centres are found to be procuring 26,000 litres of milk per day. The average chilling or the machine running time is found to be seven hours per day with a standard deviation of two hours. It can be further seen that, the minimum and maximum machine running time per day are respectively three hours and 12 hours. Due to lack of milk procurement, the average capacity utilisation of most of plants is below 50 percent indicating the under-utilisation of machineries.

8.3.3A Factors affecting procurement level

It is detected that higher DCS coverage and producer memberships contributes positively to the level of milk procurement. The operational area is negatively impacting the milk procurement at these BMCs. The larger is the area coverage by a particular BMC, the lesser is the supervision and monitoring, and hence lesser is the procurement. So in order to improve the milk procurement it is essential to have a broad DCSs coverage and the active participation (pouring) of the members in those societies.

8.3.4 Cost of purchasing

According to the level of purchasing as mentioned previously the minimum and maximum costs are depicted to be Rs.54,210 and 1,460,760 per month respectively with a mean of Rs.352,284. It may be noted here that the deductions are not always a factors where the TMS level is more than 12.5 percent. In around 80 percent of the cases there is no penalty imposed on the DCSs and hence the purchasing cost before penalty is same as the purchasing cost after penalty. The penalty is applicable for both upstream and downstream members in this case. The total purchasing is calculated to be Rs.16,909,632 for the entire month which is being expended by the unions for meeting purchasing costs. There is an average deduction of Rs.44,928 per month from the payment of the DCSs due to lesser TMS. On the other hand, an average of Rs.936 is deducted per society per month who does not meet the specifications.

8.3.5 Sales turnover and selling price

The minimum and maximum sales turnover are found to be Rs.61,050 and Rs.1,645,650 respectively per month with due penalties. In almost 70 percent of the BMC cases there is found to be no penalty whereas the rest pay penalty due to their low TMS level. The mean and standard deviations in this case are respectively Rs.396,871 and Rs.357,644. The average sales turnover of the unions is reported to be approximately Rs.19,049,808 per month. The union on an average pay Rs.50,688 (0.26 percent of sales) as penalty where the average BMC level penalty is found to be Rs.1056 per month. The sales price of milk is ranging between Rs.14.09 and 20.42 with a mean sales price of 16.48 and a profit of Rs. 0.09 thereto.

8.3.6 Cost of chilling and transportation

The cost of collection of milk is observed to be ranging between Rs1.23 and Rs.2.49. The average cost of collection is found to be Rs.1.76 whereas the standard deviation is Rs.0.28. Though the milk procurement is not substantially affecting the cost of collection still 15 percent of the variation in it could be attributed to the average milk collection by the BMCs. The cost of collection is low for the BMCs who are procuring minimum 1,500 litres of milk per day irrespective of their capacity. The cost of collection for these units is around Rs.1.58 per litre of milk.

Transportation is the major cost head accounting for 32 percent of the total operational costs followed by "salary and wages" (25 percent) and secretary commission (19 percent). Electricity (chilling) cost is another major head of expense accounting for 18 percent and all other expenses (maintenance and miscellaneous, house rent and depreciation) constitute a mere six percent of the total operational costs. Among all the major heads of expense - transportation, salary & wages and commission of the secretaries are responsible for more than 75 percent of the total expenses.

8.3.7 Profit and ROI

On an average, the profit before expenses is found to be Rs. 1.85 per litre of milk across the BMCs. After meeting various expenses it is seen that around 40 percent of them are making profit and hence their ROI is positive. In the rest of the cases the lack of profitability and negative ROI can be attributed to the lack of procurement. These loss making units over a period of time becoming sick and the unions decide to close them by stopping operation in the corresponding areas. The procurement variations could be attributed to the high proportion of local milk marketing leading to defunct of the BMCs and making losses to the unions. The net ROI of the union on behalf of all the BMCs is observed to be 5.6 percent.

8.4 Production Plant

Once the milk is delivered at the door step of the production plant, it is further taken for other processes like clarification, standardisation, pasteurisation etc.

8.4.1 Capacity utilisation vs. milk procurement

Except paneer the production capacities of the various products have been under-utilised so far. Though there is a tremendous potential for the dairy to grow, due to lack of milk procurement it's unable to produce the desired quantity of the products ultimately putting the capacity utilisation at a lower level. In certain cases due to lack of demand for a particular product in the respective operational area the production is adjusted to match the supply and demand. But above all especially in the lean season the production plants suffer due to lack of procurement and hence the production processes for the various products get hampered.

8.4.2 Cost of processing at plant level

Table 8.1: Cost of processing (figures are in percent)

Expense heads	Milk (toned)	Milk (double toned) and products
Raw materials	85	78
Processing	8	7
Packaging	3	13
Administrative	4	1
Total cost	100	100

Around 80 percent of the total cost is incurred towards the raw material acquisition followed by processing and administrative expenses. Packing costs are found to be varying from product to product depending upon their nature.

8.4.3 Quality and safety issues

The safety aspects of the plant covers three basic constituents namely men, machineries and materials. Adequate measures are being taken by the plant to prevent hazardous incidents which are intact in the production processes. In order to facilitate the process in the organisation adequate training and education programmes for the staff are arranged both by the federation and NDDB.

8.4.4 Transportation by third party logistics providers

Transportation plays a vital role in the effective and efficient performance of the supply chain. Today, in order to minimise the supply chain costs most of the activities of the firms have been outsourced. This is in accordance with the competitive strategy which the firms go on changing from time to time. In order to cope with the competitive environment, some of the firms are having a combination of both in-house and outsourced transportation. This is greatly influenced by the firm's nature of business and the size of the shipment.

8.4.4A: Operating cost and receipts for transportation

The various factors which are responsible for the aggregate transportation costs are fuel, maintenance, salary, trip related costs etc. It may be noted here that for transportation; fuel, depreciation and maintenance costs account for around 70 percent of the total operating costs. On the other side, the operating cost for out-bound transportation is found to be Rs.7.16/km where the receipt from the plant is Rs.7.60/km (average). In addition to the costs incurred by the third parties to deliver the goods to the retail outlets, they get Rs.50/day extra towards their vehicle insulation charges which is a pre-requisite to hold the tender and carrying on operations. On an average, for both in-bound and the out-bound logistics 5,000 kms is covered per day to get the products reach to the end users. From the plant side an amount of Rs.20,657 per day is expended towards transportation cost with an average of Rs.7.60 per km (receipt of the third party logistics). It is found that the average transportation cost per litre of milk is Rs.0.64 with a minimum and maximum of Rs.0.16 to Rs.1.78 respectively according to the distance covered by the vehicles.

8.4.5 Sales and profit

Currently the liquid milk market is estimated to be around 60,000 litres per day (approximately), out of which 50 percent is shared by the dairy while the informal milk market contributes to 45 percent of the same and the rest is shared by the private firms. In case of organised milk marketing, it is the dairy which contributes to more than 90 percent of the market while less than 10 percent of the market is captured by the private dairy processors. The initial outlay of the plant which was Rs.100 millions has now reached at Rs.241 millions over a period of last 10 years. The plant is growing at the rate of 10.0 percent in its operation annually with an ROI of 6.0 percent.

8.5 Retail Operations

Due to the good brand image and demand of cooperative based products it is found to have virtually a competition among the unemployed youths to acquire the agency to sell the brand. Moreover those who have got the agency are found to be making good money out of the business except a few who retail the products with an intention of expanding their parent business (7.3 percent) and hence can't concentrate on the later. Without the loss of generality it can be said the concerned business is a profitable one.

8.5.1 Retailer operational area

The retail outlets which are scattered in various geographical regions found to be operating being at a maximum distance of 120 kms from the production plant. Since the products are highly perishable in nature and need conditioned transportation, distributing in a circle of more than 100 kms radius found to be a difficult task for the plant. The higher distance from the plant sometimes is found to be a problem for the retail outlets to get the products on time and in adequate quantity as desired. In order to facilitate sales in various areas and avoid conflicts among the retailers the federation has endorsed one retail outlet in the radius of 0.5 km. But in certain cases deviations are found leading to conflicts among the retailers.

8.5.2 Sales of dairy products: The mean sale of milk by a typical retail outlet is seen to be close to 200 litres per day with a maximum of 950 litres depicting a greater spread over the milk sales. In case of milk selling the federation has kept an incentive provision of one pouch free for every 50 litres of order. The promotional milk supply provision is meant for generating more sales and revenue which in turn attracts the retailers to order for more quantity. Out of the total milk received from the plant, it is seen that around 65 percent is sold at the counter whereas the rest is sold through home delivery.

It is seen that respectively 44 percent and 24 percent of the total sales are attributed to the counter milk sales and milk sales through home delivery (higher gross profit ratio). So only milk sales constitute almost two third of the total sales per day and is a major source of earning for the retail outlets. Other demanding products are paneer and sweet curd which constitute another 16 percent of the total sales made during the day. Other products don't have substantial sales; still add to the sales in varying degrees.

8.5.2A: Sales, expenses and profit

The minimum and maximum annual sales are found to be Rs.185,000 and Rs.9,522,600respectively with an average of Rs.1,822,220. Since retailing of this kind of products is found to be a low investing and high profit making business concern interest among the shopkeepers is quite prevalent. With an average investment of Rs.45,000 annual sales turnover is found to be manifold in many cases which in turn making the business a profitable one.

The major expenses are wages detected to be house rent and electricity charges which constitute almost 75 percent of the expenses. In total an average amount of Rs.3,779 is expended by a retailer to meet all the expenses out of which wages for the labourers contribute maximum i.e. 37 percent followed by house rent (20 percent) and electricity charges (16 percent). Here “wages & salaries” and electricity charges are found to be major expenses (more than half).

It is also detected that in order to have higher sales, it is essential to incur more expenses towards these two major heads. The minimum and maximum expenses are found to be respectively Rs.617 and Rs.16,758 with a standard deviation of Rs.2,732 per month. The mean profit before taxes (after expenses) is found to be Rs.8,764 ranging from Rs.644 to a whopping Rs.52,896 per month. Return on investment is also very high as the mean profit after meeting all the expenses is a catching figure.

8.5.2B: Factors affecting retail sales

Unlike milk production which has been seen to be a women-centric activity; selling of dairy products is a man centric activity. Definitely higher investment leads to higher sales but the higher operational area is found not to be influential in sales since demand is not increased at par with the increase in the operational area. Other demographic factors are found to be ineffective for the retail sales. Higher distance from the plant, product shortages etc. are found to be negatively influencing the sales expansion.

8.5.3 Retail fill-rates

The minimum and maximum product fill rates (PFRs) are respectively found to be 30 percent and 95 percent. In contrast to this minimum and maximum order fill rates (OFRs) are found to be 20 percent and 90 percent respectively. Especially for packaged milk the PFR of 77 percent indicates that 23 percent of the market is lost because of lack of product availability. It’s also observed that due to lack of availability of dairy products (e.g. ghee) the PFR is low which in turn lowers down the overall OFR of the retailers.

8.6 Customers: The End Users

Customers are the epicentre of any business concern. The supply chain makes profit and increases the overall value, if the customers are satisfied with its output.

8.6.1 Per capita milk consumption

The existence of any business or supply chain indispensably depends upon the end users or customers of its products or services and hence no supply chain can be thought up without their active participation. The factors influencing the buying behaviour of a person are income, education, size of the family, flair for milk consumption and so on. The per capita milk consumption is found to be 270 gms per day whereas the minimum and maximum are found to be respectively 56 gms and 1,000 gms. The standard deviation in this case is detected to be around 146 gms per day which shows the fluctuations in consumption trend among the consumers according to the standard of living. The per capita consumption of milk is found to be more than the per capita availability in the country (national average of 246 gms per day).

8.6.2 Factors affecting expenditure on milk

Among all the important demographic characteristics of a person it is seen that income influences positively the expenditure to be incurred on milk and it derivatives. It is observed that as people jump from lower income group to higher income group they usually prefer to order the packaged milk from their houses where the payment is made to at the end of the month. It is observed that there is a sharp rise in expenditure when people move from lower income group (less than Rs.10,000 per month) to higher income group (Rs.20,000 to Rs.30,000 per month). The slope of the curve is higher at the origin part comparing to the slope at the subsequent part of it, indicating that the highest change occurred at the first two income groups which necessarily influence the expenditure on the dairy products. Accordingly the per capita consumption of milk varies from just 56 gms to 500 gms with a mean of 270 gms. Education and size of the family are also observed influencing the expenditure to be incurred on milk and allied dairy products.

Many a times due to inflation and the resource constraints the companies are compelled to increase the price of various products and services. But consumers are found to remain indifferent towards the expenditure which shows the inelastic behaviour of the premium product sales with respect to its price.

8.6.3 Driving forces of brand purchase

Retailer availability, product availability, quality, safety and price are five driving forces for making a purchase but it is the quality and safety of the product which take a pivotal role in the process. In some cases retailer availability and price of the product are also seemed to be important criteria especially for the people who are earning less than Rs.10,000 per month.

8.6.4 Customer satisfaction

There are seven different factors detected which are responsible to bring almost two third of the variability in the customer satisfaction namely:

i. Packaging and labelling of the products;
ii. Safety and reliability of the products;
iii. Taste of the products;
iv. Accessibility of retailers;
v. Responsiveness of the retailers;
vi. Reliability of retailers and
vii. Customer centric vision of the company.

Finally it is inferred that 73 percent of the customers are satisfied on the performance of the brand as a whole. On the contrary performance level of the aforesaid factors is also 73 percent in the market.

8.7 Supply Chain Cost and its Underlying Factors

The supply chain aims at minimising cost, maximising profit and above all maximising the stakeholders' satisfaction. The cost what is being incurred starting from milk production to the level of consumption is depicted in the below given table as a cost summary.

Table 8.2: Supply chain cost

Component	Function	Cost (Rs.)	Cost (Rs.)*
Milk producer	Production	13.66 (62.32)	14.77 (64.13)
Dairy cooperative society	Collection	0.21 (0.96)	0.21 (0.91)
Dairy coop. society to bulk milk cooler	Transporting	0.46 (2.10)	0.46 (2.00)
Bulk milk cooler	Chilling	0.76 (3.47)	0.76 (3.30)
Bulk milk cooler to production plant	Transporting	0.54 (2.46)	0.54 (2.34)
Production plant	Processing	5.63 (25.68)	5.63 (24.45)
Production plant to retail outlets	Transporting	0.66 (3.01)	0.66 (2.87)
Total supply chain	Material flow	21.92 (100.00)	23.03 (100.00

*If procurement milk price is increased

The cost of milk production is the most critical factor where the federation has to give a thought. It has been observed that due to low level of milk production at the producers' houses this is going up by 30 percent (average) by making it to a minimum level of Rs.13.66 per litre. It can be seen that processing cost is the highest and could be attributed to the low TMS value of procured milk which need addition of some more ingredients (e.g. skimmed milk powder). This increases the cost of processing to the tune of 23 percent which can be controlled by enhancing quality of the procured milk by proper awareness among the milk producers.

An amount of Re.1.00 is being expended towards the in-bound and out-bound transportation costs which can be reduced to some extent since the sub-optimal level of milk is transported due to lack of procurement and chilling at the bulk milk coolers. Already we have seen that the level of capacity utilisation is slightly more than 50 percent and hence the same level of capacity is being utilised for the transportation too which can substantially reduce the cost of transportation at least by 30 percent. The same percent of the cost can be reduced at the chilling centres if not 100 percent at least 75 percent of the plant capacity will be used.

Except the collection cost at the societies and the transportation cost from the production plant to the retailers, other interim costs can be reduced substantially if due planning and implementation of some of the processes will be into force. If these figures have been analysed properly, the interim supply chain cost could be reduced from Rs.8.26 to Rs.3.68 (55 percent). Similarly the product price could be reduced by 40 percent from Rs.21.92 to Rs.13.24. On the other hand the benefits out of this could be shared with all the stakeholders in the system so as to make them feel that they are part of the system and their participation is not only for the supply chain rather for their individual gains too.

8.8 Supply Chain Profitability

According to the current practice, the price of milk being paid to the producers is less than what they deserve. On an average their earning per litre of milk is 10 percent lesser and the introduction of the penalty system due to low TMS are making them lost in the business and hence withdrawing from the profession is quite natural. This is not only putting their lives at stake rather bringing great loss to the supply chain in procurement. Though this is realised that the producer participation and procurement are the two major susceptible areas still not much initiatives are being taken to make the supply chain competitive in the long run. Societies somewhat are making profit and hence the supply chain is bit relieved of their distress. It is also observed in case of chilling centres and hence the cost of chilling is going up and in some places due to lack of procurement they are found to be defunct. In total, though the chilling centres on behalf of the unions are not making any profit, they are not incurring any loss too, so are in the breakeven point of the profit curve.

Table 8.3: Supply chain profitability

Components	Cost price/lt (Rs.)	Processing/ collection cost/lt (Rs.)	Total cost/lt (Rs.)	Selling price/lt (Rs.)	Profit/lt (Rs.)	Remarks
Milk producer	14.77	0.00	14.77	13.66	-1.15	Loss making
Dairy coop. society	13.66	0.21	13.87	14.48	0.61	Profit making
Bulk milk cooler	14.48	1.76	16.24	16.29	0.05	Breakeven
Production plant*	16.29	5.63	21.92	19.30	-2.62	Loss making
Retail outlet	19.30	0.00	19.30	20.00	0.70	Profit making

*for packaged milk only

Keeping view to the market conditions, the production plant on the other side is unable to charge higher amount for packaged milk and hence is incurring losses for the same. But the production of the dairy products compensates the loss and hence that do not feel the problems as is being felt at the procurement side of the supply chain. Among all the stakeholders the retailers are benefitting from the supply chain by making a good profit which makes their ROI as positive. In their case the investments are usually earned in a couple of years and hence there is a competition among the existing shopkeepers and public at large to get the authorisation of the brand selling.

8.9 Identification and Assessment of Supply Chain Risks

The risks and uncertainties faced by the upstream members harm or damage the subsequent downstream members and vice versa. So a vulnerability at any point on the supply chain directly or indirectly bring damage to it since the stakeholders depend on each other for their business operations. The inference about the risks and uncertainties are depicted in the grid. It says the higher the probability and higher the severity, higher is the risk impact. On the contrary lower probability and lower severity lead to lower level risk and hence impact of the same is also low. Higher probability and lower severity or vice versa can lead to a risk with medium impact on the supply chain and hence depicted as medium risks. There are 15 risks detected across the supply chain as mentioned in the grid with their varying impact. These risks directly or indirectly affect the efficiency and effectiveness of the dairy food supply chain with two third variations. If these risks are addressed with due planning and implementation then two third of their impact on the supply chain can be mitigated. The impact of these risks and uncertainties across various levels of the supply chain are being discussed categorically.

8.9.1 Risk Grid

Severity ⇧ / Probability ⇨		Low		High
High	**Moderate (2 nos)**	Delivery risks to the plant Product shortages	**High (8 nos)**	Low milching cattle Illiteracy of milk producers Non-remunerative milk price Low milk procurement Logistical risks Hazard risks Demand unpredictability Lack of product reliability
Low	**Low (3 nos)**	Seasonal fluctuations in production Process/control/quality risks Incompatible price w.r.t pdt. quality	**Moderate (2 nos)**	High cost of fodder and medicines Leadership skills of secretaries

Figure 8.1: Risk grid for dairy industry

8.9.2 Impact of high risks on supply chain

(i) Low milching cattle: Rearing of low milching cattle brings down the level of milk production and hence increases the cost at the producers' house. It has been seen that, the higher is the production; the lower is the cost of production per litre of milk. The downstream members like the dairy cooperative societies and the bulk milk coolers in the procurement chain suffer out of the ordeal. Subsequently the production and distribution side of the supply chain also suffer and can't fulfil the demand of the customers at the end. Due to sub-optimal level of procurement, cost of chilling, transportation, processing etc.

increase and the onus is either on the supply chain as a whole or reflected in the form of price rise of the products. Profit and ROI of the supply chain also get hampered and lead to discontentment among the channel partners.

(ii) Illiteracy or ignorance of the milk producers: Illiteracy and ignorance bring up cost of production and quality deterioration at milk producers' level. Lack of understanding of the business facts bring down bargaining power at the DCS level and hence they get underpaid for their produce; which ultimately snatches their avocation over a period of time.

(iii) Non-remunerative price of milk: Non-remunerative price does not affect the cost or quality of milk directly but certainly won't entice the producers from the unorganised sector to join the societies. For the existing milk producers in the society lesser price of milk does not contribute to their income & savings which make them bankrupt over a period of time. Having suffered for a long time they usually sell of cattle and get refrained from milk production. This seriously affects the level of procurement both for the union as well as for the production plant.

(iv) Low level of milk procurement: Lower involvement of the milk producers in the societies brings down level of collections and lower level of collection in return increases the cost and decreases profit. Subsequently, lower level of milk procurement has a tremendous impact on chilling and transportation. It substantially decreases capacity utilisation of the chilling plants which ultimately increases the cost of chilling and transportation. Low procurement at the downstream supply chain leads to low production and distribution at the upstream.

(v) Logistical risks: The delay in the process deteriorates production and distribution which ultimately lead to customer dissatisfaction. Since the production plant only deals with the out-bound logistics the delay in it hampers distribution processes and cause perishability to products on the way. It is explored that the logistical risks contribute to more than half of the total risks experienced at the production plant.

(vi) Hazard risks: This kind of risks, though applicable to BMCs and the production plant, still found to be a high risk factor for the transport agencies too. Once the products handed over to these agencies at the plant, the onus of these items are borne by them and any deviation in distribution lead to penalisation. So in order to make the products reach the destination on time transporters expedite their process of delivery which sometimes brings road casualties.

(vii) Demand unpredictability: Unpredictability of demand in the market place doesn't allow the retailers to put exact advance in front of the production plant. Hence sometimes the sub-optimal level of production at the plant under-utilises the machineries and leads to downtime. On the other hand when demand is very high, procurement does not support the level of production leading to opportunity losses. This happens due to very nature of milk and lack of warehousing facilities. Moreover a product like packaged (pasteurised) milk is not stored for more than four days due to loss of food values – which is an ethical issue.

(viii) Lack of product reliability: Variations in quality and taste of the dairy products from time to time lead to customer dissatisfaction and are apparently seemed to be threats for the federation as a whole. Though this is a problem felt by the customers, still found to be a concern for the entire supply chain since they are the epicentre of the whole process. If due attention is not given to the customer service or satisfaction then market share might come down at the downstream and indirect effect of the same might be experienced at the upstream of the supply chain.

8.9.3 Impact of medium risks on supply chain

(i) High cost of fodder and medicines: Cost of fodder and medicine constitute almost 60 percent of the total cost of production. If the fodder and medicine cost increase by just 10 percent of the market price then the cost per litre is increased by Rs.1.50 to make it to Rs.16.27 per litre (earlier Rs.14.77 per litre) at the downstream. But concurrently the selling price per litre of milk does not increase and hence the percentage of loss is found to be comparatively larger.

(ii) Leadership skill of secretaries/supervisors: Lack of leadership skills incapacitates secretaries and the field supervisors to disburse their duties properly. This makes them inefficient to motivate the milk producers of a certain locality to join societies too. Sometimes they are unable to put forth the demands of the members before the union/federation and hence indirectly arouse the discontentment among the member producers. Often, it is seen that skill of secretaries/supervisors do not minimise the gap between the target versus actual milk collections at the society and chilling centre level leading to low procurement.

(iii) Delivery risks to production plant: If the milk is not delivered to the production plant on time then the production processes get affected seriously and might increase the risk of perishability on the way and any delay in it will incur more chilling costs.

(iv) Product shortages: Though demand unpredictability and product shortages seem to be apparently same still is not true. While the former is felt from the downstream members (customers); the latter is widely experienced from the upstream member (production plant). This can't cater the need of the market and sometimes leads to customer dissatisfaction (retailers and customers both).

8.9.4 Impact of low risks on supply chain

(i) Seasonal fluctuations in milk production: Seasonal fluctuation of milk production hampers the profit by increasing the cost of milk production. The milk production during lean seasons decreases by almost 30-40 percent and hence increases the cost of milk production substantially by 60 percent over the flush seasons. It is detected that the cost increases by 25 percent over the average cost of milk production unlike cost of production in flush seasons.

(ii) Process/control/quality risks: Operating the chilling plant with under-qualified persons may lead to hazards and put the machineries in obsolescence. Lower level of milk procurement on the other hand under-utilises the machineries. Overlapping of poly-pack machines stops the production process sometimes and delays in other subsequent processes like distribution. The probability of meeting quality related problems is found to be more than 0.60. Quality in terms of TMS decreases the earnings at all the level of the supply chain and leads to increase in processing costs. The production plant which caters the dairy product-needs of three districts with a geographical area of more than 16,729 square kms always faces difficulty from controlling (monitoring and supervision) issues related to production and distribution.

(iii) Incompatible price w.r.t quality: Quality and price respectively are great concerns for the customers at large. If quality is found to be inferior then it leads to customer dissatisfaction.

8.10 Strategies to Combat High Risks

The table 8.4 summarises the results of major risks and suggests the strategies to be undertaken in order to minimise their impact on the supply chain.

Table 8.4: Summary and strategies to combat high risks in dairy industry

Risk heads	Immediate risk owners	Process related	Root causes	Risk type	Initial effects	Ultimate effects	Strategies
Low milching cattle	MP	Procurement	Exorbitant price of high milching cattle	Endogenous	Low milk production, high cost of production	Loss/low profit, Low procurement	Subsidised high yielding cattle supply and loan facilities, feed management
Illiteracy of milk producers	MP, DCS	Procurement	Poverty, family influence, lack of interests to learn	Endogenous	Inefficiency in understanding business practices	Loss/low profit, lack of bargaining power	Providing education and training on regular intervals at the DCS level
Non-remunerative price of milk	DCS	Procurement	Lack of quality, policy issues	Endogenous	Discourage milk production among members	Loss of members at DCS, facilitate informal selling	Hike in price, educating the milk producers to yield quality milk with optimum feeding
Lower level of milk procurement	BMC	Procurement	Low milching cattle rearing, lack of producer involvement, informal milk sales	Endogenous	Lack of profit, high cost of processing	Defunct of DCSs and BMCs, higher processing costs	Motivating producers to join societies, increasing procurement price of milk
Logistical risks	PP	Production	Bad conditioned roads, vehicle break down, non-cooperation of retailers, perishability	Partly endo. & partly exogenous	High costs, delay in distributions, perishability	Loss/lower profit, discontentment among retailers	Proper warehousing, training & education to staff, coordination among stakeholders
Hazard risks (fire, sabotage etc.)	TA	Transportation	Accidents, political turmoil (bandhs), road blocking, bad conditioned roads	Exogenous	Delay in transport & delivery, perishability	Loss/low profit, loss of property and lives	Proper training to staff on disaster management, precautions to minimise risks
Demand unpredictability	RO	Distribution	Lack of experience, forecasting knowledge, non-coop. with PP	Exogenous	Sub-optimal/low profit, cust. dissa.	Loss of market share	Education and training to the retailers, collaboration with PP
Lack of product reliability	CUS	Distribution	Variations in quality from time to time	Endogenous	Customer dissatisfaction	Loss of goodwill and market share	Continuous quality improvement throughout the supply chain

8.11 Supply Chain Coordination

Internal resources, trustworthiness, commitment, information sharing, buyer-supplier relationships and joint-decision making etc. are the various parameters responsible for the supply chain coordination.

(i) Internal resources: In order to have a better coordination among the stakeholders it needs to have proper technology, inter and intra-personal relationships. All these items are covered in the internal sources parameter and presumed that a good coordination mechanism requires better internal resources. The internal resources could be tangible or intangible assets which are required to have a better communication process. In this way the overall score for the same have been retrieved to be 2.07 in a five point rating scale which is very low and hence the lack of internal resources found to be an impediment for the communication process.

(ii) Trustworthiness: Better supply chain coordination is possible when the stakeholders trust each other and act accordingly. For an example the milk producers are found to be complaining against the federation authorities stating that there is no field visits from the top officials, no proper grievance handling mechanism etc. and above all the kind of help they expect from the union is also seriously lacking. In this way they are losing their faith on the system and gradually withdraw from it in the long run. In this case the overall trustworthiness for the entire supply chain is at the level 1.84 and is a serious concern.

(iii) Commitment: The higher level of commitment among the supply chain partners will lead to higher procurement which will solve almost half of the problems of the supply chain. The overall commitment level of the supply chain is found to be 2.26 on a five point rating scale which depicts a below average performance of the indicator.

(iv) Information sharing: Information sharing seems not to be a problem for the entire supply chain with an overall score of 3.51. Though the level of awareness for the forecasting and intimation of the forecasting results to downstream members has been one of the crucial parts of the coordination process still found not to be practiced due to lack of expertise and interest to some extent. It is also seen in some cases that due to lack of trustworthiness information sharing is obstructed.

(v) Buyer – supplier relationship: Buyer – supplier relationship is found to attain a score of 3.07 indicating that almost in two third of the cases the relationship is maintained and hence is not an immediate threat to the coordination process.

(vi) Joint-decision making: In this case consultations between the interfaces and working together in certain situations are seemed to be in a better off position with having a score of 3.14. More specifically in two third of the cases this is practiced and in the rest it is not followed. So the scope of this could be enlarged by involving immediate stakeholders in all decision making processes both upstream and downstream.

(vii) Overall degree of coordination

Irrespective of interfaces and indicators the degree of coordination is found to be 2.65 on a five point rating scale. So it can be concluded that the degree of coordination existing in the supply chain is at an average level and hence there is a higher scope to improve further.

8.12 Supply Chain Performance

(i) Efficiency: Efficiency of the supply chain to control costs and increase "profit & ROI" is found to be 2.60 on a five point rating scale which indicates an average performance in this connection. The figure is lowering down by the less contributory score of the BMCs which are mostly incurring losses (with a score of 1.64). On the other hand the efficiency of the production plant is found to be low as the highest selling product i.e. milk is not a profitable one. Other stakeholders are seen to be performing at an average level. In aggregate the supply chain is not performing well from the view point of the cost and profit.

(ii) Flexibility: It is the indicator which shows the organisation's adaptability to change its production or delivery processes to maximise profit and customer satisfaction. The procurement chain seems to be out of purview of the flexibility which is not at all a good indication. The most vulnerable part in this case is the milk producer who produces as low as 1.5 litres of milk per day and can't be able to upkeep hybrid cattle in his shed. This is due to the low financial capability of the milk producer and non-remunerative price of milk which does not entice him/her to practice dairy farming in a fully-fledged way. So the volume flexibility is a great constrain for the entire supply chain being originated from the milk producers. The overall score in this regard is found to be 3.14 – a little better score than the efficiency of the supply chain.

(iii) Responsiveness: Due to low volume of production the fill rate of the milk producers has come down influencing the fill rates of entire downstream supply chain. Variations in TMS level at the reception desk of the production plant bring down the performance of the responsiveness parameter of the BMCs. Many a times, this leads to altercations and impose of penalty by the plant authorities thereto bringing discontentment among the union officials.

The production plant is found to be less agile to respond to the customers (retailers), which ultimately decreases the overall performance of the supply chain in this regard. Retail outlets sometimes deliver damaged and leaked products to the customers and demand more money than the maximum retail price on the pretext of refrigeration which leads to customer dissatisfaction. The overall responsiveness of the supply chain is found to be 2.50 (poor) which require further attention of the stakeholders.

(iv) Product quality: Product appearance, taste and safety indicators are found to be working well and hence the score for the supply chain in this case is 3.57 depicting a good performance. Especially the production plant is seen to be proactive and taking necessary action in maintaining quality of the product above all. But the price-quality mismatch of the products should be minimised to avoid customer dissatisfaction issues in the distribution chain. Among all the parameters it is the product quality which is performing better and hence the overall supply chain performance is raised.

(v) Process quality: The performances in case of working condition and chemical usages etc. are quite similar in the supply chain operations. Energy and water usages are maintained at an optimal level and found to be concerns for the production plant only. Sales promotion figures out well in the chain wherein a relatively better performance is essential in case of the retail outlets. As long as store display and the customer services are concerned, it is the retailers who need to upgrade their performance to little above than current performance (3.05). The process quality indicator scores relatively lesser than the product quality but the two variables seem to do well throughout the supply chain. The overall supply chain score in this case is found to be 3.35 – a better score than other indicators excepting the product quality.

(vi) Component-wise performance: who needs to improve where?

From the view point of efficiency considerations bulk milk coolers, production plant and transporting agencies need to perform better by minimising the costs. Though minimising costs at the transporter level might not be an easier task due to high cost of fuels (keeps rising further) still a judicious planning of the distribution route might help improve their performance in this regard. Responsiveness of the retail outlets is also required to perform better in order to strengthen the distribution chain. Supply chain performance in this case is coming down due to lesser flexibility and low level of responsiveness. In order to improve the performance of the supply chain it is highly essential to concentrate on these two aspects especially at the level of milk producer and bulk milk cooler.

8.13 Supply Chain Summary

Since the flexibility and responsiveness is found to be susceptible and scoring less in most of the cases, it can be said that, "the supply chain is efficient but not an effective one". Including the customer satisfaction and the risk coping efficiency of the stakeholders it is found to be operating at a level of 2.65 which is an average performance score. According to the discussions made in various sections of the analysis it is inferred that the supply chain to be:

- Independent (purchasing function is not strategic)
- Efficient (cost is the primary objective)
- Non-flexible (unable to change as per market demand)
- Un-responsive (low fill rate i.e. mismatch in target and actual)
- Risk averse (risk coping efficiency is low)
- Un-coordinated (degree of coordination among stakeholders is low)
- Customer centric (customers are paid due attention)

8.14 Results of Hypotheses Framed

Out of 20 hypotheses framed under various objectives 11 are found to be accepted while the rest are deemed to be rejected. The repercussions of the hypotheses could be realised with respect to their nature. The component-wise inferences of framed hypotheses are depicted in the table below.

Table 8.5: Inferences of hypothesis

Sl. No.	Hypotheses	Level	Result
1	Participating in the supply chain brings down cost of production	Milk producer	Rejected
2	Participating in the supply chain lowers down risks & uncertainties	Milk producer	Rejected
3	Participating in the supply chain improves overall performance	Milk producer	Rejected
4	Higher is the membership higher is the amount of milk collection	Dairy cooperative society	Rejected
5	The larger the pouring members (low pouring capacity) the higher is the level of collections	Dairy cooperative society	**Accepted**
6	Higher pouring capacity (low pouring members) of producer members increases the level of collection	Dairy cooperative society	Rejected
7	The larger is the operational area the higher is the level of procurement	Bulk milk cooler	Rejected
8	The larger is the DCS base the higher is the level of procurement	Bulk milk cooler	**Accepted**
9	The higher is the milk producer participation (active members) the higher is the quantum of procurement	Bulk milk cooler	**Accepted**
10	The higher is the level of procurement the lower is the cost of chilling	Bulk milk cooler	**Accepted partially**
11	Retailing of dairy products is a low investing and high profit making business concern	Retail outlet	**Accepted**
12	Higher is the area of operational area higher is the sales	Retail outlet	Rejected
13	There is a high degree of positive correlation between income and expenditure on dairy products	Customer	**Accepted partially**
14	Customers are increasingly becoming quality conscious while making a purchase	Customer	**Accepted**
15	Risk and uncertainties exist at each level of the supply chain	All components	**Accepted**
16	Endogenous risks have more chances of occurrence than exogenous ones	All components	Rejected
17	Higher is the trust higher is the level of commitment and better is the buyer-supplier relationship in the supply chain	All components	**Accepted**
18	The higher is the degree of supply chain coordination the lower is the risk	All components	**Accepted**
19	There is a difference in the performance level of stakeholders	All components	Rejected
20	Supply chain performance is positively influenced by the risk coping efficiency of the stakeholders	All components	**Accepted**

Out of the 20 hypotheses framed 11 hypotheses are found to be accepted and the rest are deemed to be rejected.

8.15 Comparing Dairy Federations in India

Data from various sources like NDDB, Ministry of Agriculture, Indiastat etc. (table provided in the introduction chapter) have been complied together to make a comparison of all major dairy federations in the country. The rationale behind this is to provide a benchmarking platform to the dairy federation of Orissa to compare with others and take necessary steps accordingly to upgrade the weaker sections of dairy food supply chain.

8.15.1 Top performing dairy federations in various fields

- Society formulation: MP, UP, Rajasthan, Gujarat, Karnataka
- Farmer membership (man): Gujarat, Karnataka, Tamil Nadu, MP, UP
- Farmer membership (woman): Tamil Nadu, Gujarat, Karnataka, MP, UP
- District coop. union formulation: UP, Maharashtra, Rajasthan, WB, Karnataka
- Production plant set up: Maharashtra, Gujarat, UP, Rajasthan, Karnataka
- Production plant processing capacity: Gujarat, MP, Tamil Nadu, AP, Karnataka
- Milk procurement : Gujarat, Maharashtra, Karnataka, Tamil Nadu, Rajasthan
- Liquid milk marketing: Gujarat, Maharashtra, Karnataka, Tamil Nadu, AP
- AI programme conducting: Karnataka, AP, Tamil Nadu, Punjab, UP

Keeping view to major indicators together with average milk collections at society, union, average milk marketing per dairy and so on the following rankings are done.

8.15.2 Ranking of dairy federations

Based on the society formulation, members, women participation, milk procurement, production plant processing capacity, milk marketing etc. the following ranking is done. The mean ranking of a federation is calculated on the basis of rankings on various parameters as stated above. Higher values indicate higher ranking. By Friedman Rank test the ranks are significant at 5 percent level of significance with a Chi-square value of 75.10 and 14 degrees of freedom (df). It is inferred that Gujarat, Karnataka and Tamil Nadu are the top performing dairy federations in the country (table below). The state of Orissa is performing poor almost in all basic indicators of cooperative based dairying which is clearly reflected in the primary data interpretations. The following suggestions are given to strengthen the concerned dairy federation of the state. The suggestions are also applicable to other federations in the country, aiming to improve the cooperative based dairying.

Table 8.6: Overall ranking of dairy federations on various parameters

Sl. No.	State	Dairy federation	Brand	Mean ranking
1	Gujarat	GCMMF	Amul	12.50
2	Karnataka	KMF	Nandini	12.44
3	Tamil Nadu	TCMPF	Avin	12.06
4	Uttar Pradesh	PCDF	Parag	10.89
5	Rajasthan	RCDF	Saras	10.11
6	Maharashtra	MRSDMM	Vikas	9.78
7	Andhra Pradesh	APDDCF	Vijaya	9.67
8	Punjab	MILKFED	Verka	7.72
9	Madhya Pradesh	MPCDF	Sanchi	7.67
10	Kerala	KCMMF	Milma	6.33
11	West Bengal	WBCMPF	Ben's	6.00
12	Haryana	HDDCF	Vita	5.33
13	Bihar	COMPFED	Sudha	4.89
14	Orissa	OMFED	OMFED	3.44
15	Himachal Pradesh	HPSCMPF	Him	1.17

8.16 Suggestions and Recommendations

The supply chain management is a very complex process to deal with. In a dairy food supply chain where the milk producers demand a fair price for their produce, customers want a qualitative product at reasonable price. So managing these two independent bodies is found to be an extremely difficult task for the dairy federations. At the upstream supply chain procurement is a challenge, whereas quality is a problem at the downstream. Hence if these two issues are tackled properly then almost half of the problems are solved. Still in order to fortify the dairy food supply chain operation the following items are recommended.

- **Milk producer level:** The supply chain is operating with a higher cost due to low procurement and inferior quality of milk. Low procurement is a repercussion of non-remunerative price for raw milk at the procurement chain. Being the suppliers, the milk producers feel underpaid and over a period of time they get restrained from producing milk. This not only snatches their avocation in the long run rather disrupt the supply chain from smooth functioning. At this level, increasing the procurement price is inevitably essential to raise the level of procurement at the society. Feed and fodder supply is not enough and need to be supplied according to the requirement of the members in the societies. Quality of feed and fodder should be improved in order to make it more acceptable among the members. Milk producers themselves should try to maintain a standard level of milk production while upgrading quality by rearing high yielding cows.

- **Dairy cooperative society level:** Secretaries of societies and/or supervisors of the union should improve their skills to organise milk producers in the rural areas. They should participate in various training programmes to learn the basic issues of leaderships and motivation. They should also be sent to societies of other brands (like Amul or Nandini etc.) to learn the core competencies for improving level of procurement at the society. Through this they can also be able to identify and assess their strengths and weaknesses. Efforts should be made to attract the large milk producers towards the system. Along with the small and marginal milk producers they will increase the procurement at the society level. Retention of the existing members in the society should be given priority and efforts should be made to unearth the reasons for their attrition. Infrastructure of the societies should be strengthened to facilitate coordination process.
- **Bulk milk cooler level:** Instead of opening of new societies in a particular area endeavours should be made to strengthen the existing ones and chilling facility may be provided at the society level so that perishability of milk can be minimised at the society itself. Regular field visit of the top officials of the union/federation is highly essential to build up trust and commitment among the suppliers (milk producers). Efforts should be made to evaluate the milk producers on regular intervals so that their value addition to the supply chain can be assessed. If required they should be provided with necessary financial help and high yielding cattle to produce and sell milk to society thus implementing Contract Farming Schemes in the system. Penalty ceiling of 12.5 percent total milk solids (TMS) should be reconsidered and might be reduced to 12.0 percent keeping view to the TMS level of indigenous and crossbred cows.

- **Production plant level:** Necessary care should be taken to handle milk and products to avoid process and in-transit losses. Quality of the product should be improved and due care should be given to control it both upstream and downstream. Quality-price mismatch can be minimised in order to increase customer satisfaction. Availability of milk in small packets (like 250 ml or so) should be made possible so as to make it more popular among lower income groups. Rural milk markets might be tapped in order to hike sales. Customer satisfaction and complaints should be given due importance and certain demanding products (like ghee) should be made available as per requirement.
- **Transporting agency level:** Judiciously milk distribution routes should be planned so as to reduce the operating costs. Necessary care should be taken to avoid logistics related risks and hazards. Drivers and cleaners of the distribution vehicles should be well trained to efficiently disburse their duties while maintaining a good public relationship with the retailers and plant authorities.
- **Retail outlet level:** Credit facility to the retailers should be provided and demanding products should be supplied as per their requirements. Suboptimal level of supply will give rise to opportunity loss. Retailers should be trained to forecast the demand of various products of the brand so as to assist the plant/federation in production/demand forecasting to minimise perishability. Once the demand is forecasted the demand-supply gap will be easier to deal with. Thus the higher demand of certain products will motivate concerned stakeholder to look back the downstream supply chain.
- **Federation level:** Before taking any decision regarding the procurement milk price with the government officials/bureaucrats, attention should be given towards the milk suppliers in the rural areas about their cost of productions. The milk producers should be trained enough to calculate their own cost of milk productions (roughly) so as to control it to some extent. More importantly purchasing function should be viewed as a matter of strategic importance. Retail margin on packaged milk might be reduced and the same can be diverted to upstream. The incentives on performance and bonus distribution schemes should be invigorated and practiced on regular basis. Instead of focussing on cost reductions always, efforts should be made to maximise stakeholders' satisfaction. Programme implementations should be followed by due monitoring and supervision so as to encourage the stakeholders in the field. This way trust on the system can be built up while minimising the malpractices.

- **For all stakeholders:** Efforts should be made by all the stakeholders in the system to coordinate with each other by facilitating joint decision making and information sharing. Trusting each other and working hard (commitment) are required to be groomed both upstream and downstream to increase the effectiveness of the supply chain. This way a collaborative work environment can be established to increase overall stakeholder satisfaction.

8.17 Direction for Future Research

Even if India is the largest producer of milk in the world, still it is not a major player in dairy trade. New Zealand having one fifth of its productions is on the top list of dairy trade and commerce. So a comparative study between these two countries can be made to analyse the drivers and barriers of dairy trade and commerce. Research works for supply chain risk, coordination and performance can be further carried out and hypotheses can be verified to strengthen the ideas. Especially the intangible items of coordination and performance (e.g. “trustworthiness and commitment of coordination” and “responsiveness, product quality and process quality of performance”) can be studied to broaden the service operations of a manufacturing supply chain – irrespective of industries.

8.18 Conclusion

The dairy-food supply chain is highly a riskier business concern to deal with. No matter what the precautions are taken, risks and uncertainties can’t be ruled out from the industry. Since it is not possible to avoid them completely, a proper risk redressal mechanism could at least minimise their impact on supply chain performance. A basic priority for the dairy industry is to ensure that products distributed to the customers are safe and suitable for consumption. Milk borne injuries can be extremely fatal leading to unnecessary litigations by tarnishing the image of the organisation in the long run. An efficient and effective supply chain operation could provide hygienic measures throughout the supply chain by adhering to the proper food value requirements of the consumers at large.

BIBLIOGRAPHY

Abratt, R., & Pitt, L. F. (1985). Pricing practices in two industries. *Industrial Marketing Management, 14, 301-306.*

Acharya, B. P. (2001). *Economics of milk production*. Chennai: Sai Shriram Publishers.

American Productivity & Quality Centre. (1992). *Basics of benchmarking.* Houston: Author.

Aramyan, L., Ondersteijn, C., Van Kooten, O., Oude Lansink, A. (2006). Performance indicators in agri-food production chains. In C. J. Ondersteijn, J. H. Wijnands, R. B. Huirne, & O. van Kooten (Eds), *Quantifying the agri-food supply chain* (pp. 47-64). Dordrecht: Springer.

Banbury, J. G. (1975). Distribution – The final link in the electricity supply chain. *Electronics and Power Journal of the Institution of Electrical Engineers, 21*(13), 773-775.

Barlow, J. F. (2005). *Excel models for business and operations management* (2nd ed.). UK: John Wiley & Sons.

Beamon, B. M. (1998). Supply chain design and analysis: Models and methods. *International Journal of Production Economics, 55*(3), 281-294.

Beamon, B. M. (1999b). Designing the green supply chain. *Logistics Information Management*, 12(4), 332-342.

Berry, L. (2006). *On Great Service: A framework for action*. New York: The Free Press.

Bititci, U. S., Carrie, A. S., & McDevitt, L. (1997). Integrated performance measurement systems: A development guide. *International Journal of Operations & Production Management, 17*(5), 522-534.

Bojadziev, G., & Bojadziev, M. (2007). *Fuzzy logic for business, finance and management* (2nd ed.). Singapore: World scientific Publishing.

Braithwaite, A., & Parsons, R. (2001). *Supply chain thinking and practice - Enabled by a performance management framework.* UK: Cranfield School of Management, Supply Chain Knowledge Centre.

Burt, D. N., Dobler, D. W., & Starling, S. L. (2003). *World-class supply management: The key to supply chain management*. New York: McGraw-Hill.

Byrne, P. J. (2006). The impact of information sharing and forecasting in capacitated industrial Supply chains: A case study. *International Journal of Production Economics, 103*, 420-437.

Chaffe, B. C. (2001). *Information logistics: Outsourcing solutions can improve productivity*. Washington: University of Washington, Graduate School of Business.

Chan, F. T. S., & Qi, H. J. (2003). An innovative performance measurement method for supply chain management. *Supply Chain Management: An International Journal, 8*(3-4), 209-223.

Chase, R. B., Aquilano, N. J., & Jacobs, F. R. (1999). *Production and operations management: Manufacturing and services*. New Delhi: Tata McGraw-Hill.

Childerhouse, P., & Towill, D. R. (2002). Analysis of the factors affecting the real-world value stream performance. *International Journal of Production Research, 40*(15), 3499-3518.

Christopher, M. G. (1998). *Logistics and supply chain management: Strategies for reducing cost and improving service*. Harlow: Financial Times - Prentice Hall.

Churchill, G. A. (1999). *Marketing research: Methodological foundations*. Orlando, FL: The Dryden Press.

Cox, A. (1999). Power, value and supply chain management. *Supply Chain Management: An International Journal, 4*(4), 167-175.

Cramer, G. L., Jensen, C. W., & Douglas, D. S., Jr. (1997). *Agricultural economics and agribusiness* (7th ed.). New York: John Wiley & Sons, Inc.

De Toni, A., & Tonchia, S. (2001). Performance measurement systems: Models, characteristics and measures. *International Journal of Operations & Production Management, 21*(1/2), 46-70.

Dutta, S., Zbaracki, M., & Bergen, M. (2003). Pricing process as a capability: A case study. *Strategic Management Journal, 24*, 615-630.

Ellram, L. M. (1991). A managerial guide for the development and implementation of purchasing partnerships. *International Journal of Purchasing and Materials Management, 27*(3), 2-8.

Fisher, M. L. (1997). What is the right supply chain for your product? *Harvard Business Review*, 105-116.

Frohlich, M. T., & Westbrook, R. (2001). Arcs of integration: An international study of supply chain strategies. *Journal of Operations Management, 19*, 185-200.

Goswami, B. (2007). Can Indian dairy cooperative survive in the new economic order? *Proceedings of WTO Public Forum, Geneva*, 112-117.

Graham, T. S., & Dougherty, P. J. (1994). The long term strategic impact of purchasing partnerships. *International Journal of Purchasing and Materials Management, 30*(4), 13-18.

Gunasekaran, A., Patel, C., & Tirtiroglu, E. (2001). Performance measures and metrics in a supply chain environment. *International Journal of Operations & Production Management*, *21*(1/2), 71-87.

Hall, R. L., & Hitch, C. J. (1939, May). Price theory and business behaviour. *Oxford Economic Papers, 2*, 12-45.

Handfield, R. B. & Nichols, E. L. (1999). *Introduction to supply chain management*. New Jersey: Prentice Hall.

Harrington, L. (1996, July). Untapped savings abound. *Industry Week, 15*, 53-58.

Hayes, R., Pisano, G., Upton, D., & Wheelwright, S. (2005). *Operations, strategy, and technology: Pursuing the competitive edge*. Hoboken, NJ: John Wiley & Sons, Inc.

Herbig, P., & O'Hara, B. (1996). International procurement practices: A matter of relationships. *Management Decision, 34*(4), 41-45.

Hill, T. (2000). Manufacturing strategy (2nd ed.). New York: Palgrave.

Hobbs, J. E. (1996). A transaction cost approach to supply chain management. *Supply Chain Management: An International Journal, 1*(2), 15-27.

Hoole, R. (2005). Five ways to simplify your supply chain. *Supply Chain Management: An International Journal, 10*(1), 3-6.

Hoover, W. E., Eloranta, E., Holmström, J., & Huttuen, K. (2001). *Managing the demand: Supply chain- value innovations for customer satisfaction*. Wiley: New York.

Horvath, L. (2001). Collaboration: Key to value creation in supply chain management. *Supply Chain Management: An International Journal, 6*(5), 205-207.

Hsieh, P. J., & Kleiner, B. H. (1992). New developments in inventory and materials management. *Logistics Information Management, 5*(2), 32 - 35.

Hull, B. (2002). A structure for supply-chain information flows and its application to the Alaskan crude oil supply chain. *Logistics Information Management, 15*(1), 8-23.

Hvolby, H. H., & Trienekens, J. (2002). Supply chain planning opportunities for small and medium sized companies. *Computers in Industry, 49*(1), 3-8.

Johnston, P. (1995). Supply chain management: Past, the present and the future. *The Manufacturing Engineer*, 213-217.

Jones, M., & Towill, R. D. (1997). Enlightening supplies. *Manufacturing Engineering, 3*, 156-160.

Jones, M., & Towill, R. D. (1998). Time compression in the supply chain: Information management is the vital ingredient. *Logistics Information Management, 11*(2), 93-104.

Jones, T. C., & Riley, D. W. (1985). Using inventory for competitive advantage through supply chain management. *International Journal of Physical Distribution & Materials Management, 15*(5), 16-26.

Kaplan, A. D. H., Dirlam, J. B., & Lanzillotti, R. F. (1958). *Pricing in big business: A case approach*. Washington, DC: The Brookings Institution.

Kaplan, R. S., & Norton, D. P. (1992). The balanced scorecard: Measures that drive performance. *Harvard Business Review, 70*(1), 71-99.

Kaplan, R. S., & Norton, D. P. (1996). *The balanced scorecard*. Boston: Harvard Business School Press.

Kapoor, S. K., & Kansal, P. (2003). *Marketing logistics: A supply chain approach*. Singapore: Pearson Publications.

Keebler, J .S. (1999). *Keeping score: Measuring the business value of logistics in the supply chain*. Oak Brook: Council of Logistics Management.

Krajewski, L. J., & Ritzman, L. P. (2000). *Operations management: Strategy and analysis* (5th ed.). Singapore: Addison Wesley Longman Publications.

Lai, K. H., Ngai, E. W. T., & Cheng, T. C. E. (2002). Measures for evaluating supply chain performance in transport logistics. *Transportation Research (part E): Logistics and Transportation Review, 38*(6), 439-456.

Lal, R., Quelch, J. A., & Kasturi Rangan, V. (2005). *Marketing management: Text and cases*. New Delhi: Tata McGraw-Hill.

Lambert, D. M., & Pohlen, T. L. (2001). Supply chain metrics. *The International Journal of Logistics Management, 12*(1), 1-19.

Lambert, D. M., Emmelhainz, M. A., & Gardner, J. T. (1999). Building successful partnerships. *Journal of Business Logistics, 20*(1), 165-181.

Lee, H. L. (2000). Creating value through supply chain integration. *Supply Chain Management Review, 4*(4), 30-36.

Lee, H. L., & Billington, C. (1992). Managing supply chain inventory: Pitfalls and opportunities. *Sloan Management Review, 33*, 65-73.

Levy, D. L. (1997). Lean production in an international supply chain. *Sloan Management Review, 38*(2), 94-102.

Li, D., & O'Brien, C. (1999). Integrated decision modelling of supply chain efficiency. *International Journal of Production Economics, 59*(1-3), 147-157.

Lockamy, A., & McCormack, K. (2004). Linking SCOR planning practices to supply chain performance. *International Journal of Operations & Production Management, 24*(12), 1192-1218.

Lowson, R. H. (2009). *Strategic operations management: The new competitive advantage*. New York: Routledge Publications.

Luning, P. A., Marcelis, W. J., & Jongen, W. M. F. (2002). *Food Quality Management: A Techno Managerial Approach*. Wageningen: Wageningen Academic Publishers.

MacBeth, D. K., & Ferguson, N. (1994). *Partnership sourcing: An integrated supply chain management approach*. London: Pitman Publishing.

Mahadevan, B. (2007). *Operations management: Theory and practice*. New Delhi: Pearson Publications.

Malhotra, N. K., & Dash, S. (2009). *Marketing research: An applied orientation* (5th ed.). New Delhi: Dorling Kindersley (India) Publications.

Maloni, M. J., & Benton, W. C. (1997). Supply chain partnerships: Opportunities for operations research. *European Journal of Operational Research, 101*(10), 1020-1033.

Mapes, J., New, C., & Szwejczewski, M. (1997). Performance trade-offs in manufacturing plants. *International Journal of Operations & Production Management, 17*(10), 1020-1033.

Martinich, J. S. (1997). *Production and operations management: An applied modern approach*. Singapore: John Wiley & Sons.

Monczka, R. M., Petersen, K. J., Handfield, R. B., & Ragatz, G. L. (1998). Success factors in strategic supplier alliances: The buying company perspective. *Decision Sciences, 29*(3), 553-577.

National Dairy Development Board. (n.d). *Milk procurement and technical inputs manual*. Anand: Author.

Novac, R. A., & Simco, S. W. (1991). The industrial procurement process: A supply chain perspective. *Journal of Business Logistics, 12*(1), 145-167.

Novich, N. (1990). Distribution strategy: Are you thinking small enough? *Sloan Management Review, 32*(1), 71-77.

Oliver, R. L., & Webber, M. D. (1982). Supply chain management: Logistics catches up with strategy. In M. Christopher (Ed.), *Logistics: The strategic issues* (pp. 63-75). London: Chapman & Hall.

Parasuraman, A., Berry, L. L., & Zeithaml, V. A. (1991). Understanding customer expectations of service. *Sloan Management Review, Spring*, 39-48.

Persson, F., & Olhager, J. (2002). Performance simulation of supply chain designs. *International Journal of Production Economics, 77*(3), 231-245.

Porter, M. E. (1985). *Competitive advantage: creating and sustaining superior performance*. New York: Free Press.

Rao, V. M. (2004). *Empowering rural women: Through dairy cooperatives*. New Delhi: Anmol Publications.

Rosenau, M. D., Griffin, A., Castellion, G. A., & Anschuetz, N. F. (1996). *The PDMA handbook of new product development*. New York: Wiley.

Rushton, A., & Oaxly, J. (1991). *Handbook of logistics and distribution management*. London: Kogan Page.

Russell, R. S., & Taylor, B. W. (2006). *Operations management* (4th ed.). New Delhi: Pearson Publications.

Sachan, A., Sahay, B. S., & Sharma, D. (2005). Developing Indian grain supply chain cost model: System dynamics approach. *International Journal of Productivity and Performance Management, 54*(3), 187-205.

Shah, D. R. (1985). *Cooperative dairy farming in Gujarat*. Bombay: Somaiya Publishers.

Shipley, D. D, & Bourdon, E. (1990). Distributor pricing in very competitive markets. *Industrial Marketing Management, 19*, 215-224.

Shipley, D. D. (1981). Pricing objectives in British manufacturing industry. *Journal of Industrial Economics, 29*(June), 429-443.

Simatupang, T. M., Sandroto, I. V., & Lubis, S. B. H. (2004). Supply chain coordination in a fashion firm. *Supply Chain Management: An International Journal, 9*(3), 256-268.

Simons, R. (2000). *Performance measurement and control systems for implementing strategy*. Englewood Cliffs, NJ: Prentice Hall.

Singh, J. (1996). The importance of information flow within the supply chain. *Logistics Information Management, 9*(4), 28-30.

Skinner, R. C. (1970). The determination of selling prices. *Journal of Industrial Economics, 18*, 201-217.

Slack, N. (1998). *Encyclopedic dictionary of operations management* (Ed.). Oxford: Blackwell Publishers Ltd.

Slack, N., Chambers, S., Harland, C., Harrison, A., & Johnston, R. (1995). *Operations management*. London: Pitman Publishing.

Stewart, G. (1995). Supply chain performance benchmarking study reveals keys to supply chain excellence. *Logistics Information Management, 8*(2), 38-44.

Svensson, G. (2002). The theoretical foundation of supply chain management: A functionalist theory of marketing. *International Journal of Physical Distribution & Logistics Management 32*(9), 734-754.

Thomas, D. J., & Graham, T. S. (1996). Coordinated supply chain management. *European Journal of Operational Research, 94*(3), 1-15.

Thomas, D. J., & Griffin, P. M. (1996). Coordinated supply chain management. *European Journal of Operational Research, 94*(3), 1-15.

Towill, D. R., Naim, N. M., & Wikner, J. (1992). Industrial dynamics simulation models in the design of supply chains. *International Journal of Physical Distribution and Logistics Management, 22*, 3-13.

Udell, J. G. (1964). How important is pricing in competitive strategy. *Journal of Marketing, 28*(January), 44-48.

Valeeva, N. I. (2005). *Cost-effectiveness of improving food safety in the dairy production chain*. Unpublished doctoral dissertation, Wageningen University, Wageningen, Netherlands.

Van der Spiegel, M. (2004). *Measuring effectiveness of food quality management*. Unpublished doctoral dissertation, Wageningen University, Wageningen, Netherlands.

Van der Vorst, J. G. A. J. (2000). *Effective food supply chains. Generating, modelling and evaluating supply chain scenarios*. Unpublished doctoral dissertation, Wageningen University, Wageningen, Netherlands.

Van der Vorst, J. G. A. J. (2005). Performance measurement in agri-food supply chain networks: An overview. In C. J. Ondersteijn, J. H. Wijnands, R. B. Huirne & O. van

Kooten, (Ed.), *Quantifying the Agri-food Supply Chain* (pp.13-24), Dordrecht: Springer.

Van Hoek, R. I. (1998). Measuring the un-measurable – Measuring and improving the performance in the supply chain. *Supply Chain Management: An International Journal, 3*, 187-192.

Vickery, S. K., Jayaram, J., Droge, C., & Calantone, R. (2003). The effects of an integrative supply chain strategy on customer service and financial performance: An analysis of direct versus indirect relationships. *Journal of Operations Management, 21*, 523–539.

Vitale, M. R., & Mavrinac, S. C. (1995). How effective is your performance measurement system. *Management Accounting, 77*(2), 43-47.

Vohra, N. D. (2008). *Quantitative techniques in management* (3rd ed.). New Delhi: Tata McGraw Hill Publications.

Voss, C. A. (1995). Operations management - From Taylor to Toyota and beyond. *British Journal of Management, 6*, 17-29.

Wentz, T. E. (1966). Realism in pricing analyses. *Journal of Marketing, 30*(April), 19-26.

Wight, O. W. (1995). *Manufacturing resource planning - MRP II: Unlocking America's productivity potential* (2nd ed.). New Hampshire: John Wiley and Sons.

Wijnands, J. H., & Ondersteijn, C. (2006). *Quantifying the agri-food supply chain*. Dordrecht: Springer.

Womack, J., & Jones, D. (2002). *Seeing the whole: Mapping the extended value stream.* Cambridge, MA: Lean Enterprise Institute.

Woodruff, R. B. (1997). Customer value: The next source for competitive advantage. *Journal of Academy of Marketing Science, 25*(2), 139-153.

APPENDIX A1

PRAMOD KUMAR MISHRA — **SCHOOL OF MANAGEMENT STUDIES**

DOCTORAL RESEARCHER — **UNIVERSITY OF HYDERABAD**

HYDERABAD

QUESTIONNAIRE FOR THE MILK PRODUCERS

Purpose of the study: The questionnaire is designed to collect data to be purely used for the Doctoral Research purpose. The data provided by you will be kept as top secret and under any circumstances won't be revealed to any individual or organisation.

Instructions: Please tick the appropriate boxes and give necessary information wherever required.

1. Contact details:

Name	
Village	
Tehsil	
District	
Phone	

2. Gender:

Male	☐	Female	☐

3. Age:

Age (years)	

4. Education:

Illiterate	☐	Read and write	☐
Primary	☐	High School	☐
College	☐	Any other (please specify):	

5. Occupation:

Occupations	Main	Subsidiary
Agricultural or other labour	☐	☐
Cultivation	☐	☐
Dairy farming	☐	☐

Trade/Business	☐	☐
Service (Private/Govt.)	☐	☐
Any other (please specify)		

6. Land holding:

Less than 2 acres	☐	2 to 4 acres	☐
4 to 10 acres	☐	More than 10 acres	☐

7. Annual income:

Annual income (Rs.)	

8. Cattle-wise distribution of milk production:

Category	Nos	Milk yield/day (March-August)	Milk yield/day (September-February)	Milk yield/day (Yearly average)
Indigenous cows				
Crossbred cows				
Jersey cows				
Buffaloes				

9. Solid contents of milk produced:

Fat percent of milk (percent)		Solid-not-fat content of milk (percent)	

10. Years of experience in dairy farming and society:

Years of experience in dairy farming		Years of association in society	

11. Society distance from house:

Less than 0.5 km	☐	0.5 to 1.0 km	☐
1.0 to 1.5 kms	☐	More than 1.5 kms	☐

12. Mode of transportation/conveyance to society:

Walking	☐	Cycling	☐

13. Contractual agreement:

Milk producer vs. society (please specify)	

14. Receiving of payment on time:

Receiving of payment on time	Yes	No
	☐	☐
Comments (if any)		

15. Target milk delivery:

Is there any target given for milk delivery	Yes	No
	☐	☐
Comments (if any)		

16. Awareness of cost of milk production:

Calculation of cost of milk production	Yes	No
	☐	☐

17. Factors of milk production:

Fixed cost heads	Cost (Rs.)	Variable cost heads/month	Cost (Rs.)
Infrastructure		Fodder and concentrates	
Cattle		Labour cost	
Equipments		Health and medicines	
Total assets		Overheads	

18. Solid contents of milk produced:

Fat (percent)		Solid-not-fat (percent)	

19. Milk sales:

Sales to society (litres)		Sales to open market (litres)	

20. Perceptions towards the society:

Perceptual statements against society	Strongly disagree	Disagree	Indifferent	Agree	Strongly agree
Nearer to the farm/house	☐	☐	☐	☐	☐
Convenient means to sell the produce	☐	☐	☐	☐	☐
Makes payment on regular basis	☐	☐	☐	☐	☐

Provides loans and financial help in need					
Provides fodder, veterinary help at a reasonable price					
Provides education and training to nurture business skills					
Provides technical expertise and valuable information					
Improves income and savings					
Strengthens societal relationships					
Any other (please specify):					
Participation at the society adds value to milk prod./sales					

21. Supply chain risk issues:

Supply chain risk factors	Frequency/likelihood					Severity				
	Very low	Low	Neither high nor low	High	Very high	Insignificant	Minor	Neither serious nor minor	Serious	Catastrophic
High cost of feed and fodder										
Illiteracy and ignorance										
Lack of coop. & info. sharing										
Low-milching cattle rearing										
Mortality rate of cattle										
Non-remunerative milk price										
Penalty related issues										
Perishability of milk										
Seasonal fluctuations										
Any other:										
Dairy farming is a riskier occupation										

22. Supply chain coordination issues:

Perceptions towards supply chain coordination	Strongly disagree	Disagree	Indifferent	Agree	Strongly agree

Insufficient internal resources is a barrier to communication	☐	☐	☐	☐	☐
Closely working with the society/union is highly essential	☐	☐	☐	☐	☐
Trusting each other and believing in long term relationship	☐	☐	☐	☐	☐
Stakeholders should work hard to maintain good relationships	☐	☐	☐	☐	☐
Hesitation in collecting and disseminating information	☐	☐	☐	☐	☐
Sharing responsibilities will help improve the sector	☐	☐	☐	☐	☐
Lack of cooperation among stakeholders is an obstacle	☐	☐	☐	☐	☐
Difficult to assess material benefits of long term relationships	☐	☐	☐	☐	☐
Overall coordination among stakeholders is highly essential	☐	☐	☐	☐	☐

23. Supply chain performance issues:

Supply chain indicators	Supply chain sub-indicators	Very low	Low	Neither high nor low	High	Very high
Efficiency	Facilities costs (cost of production)	☐	☐	☐	☐	☐
	Transportation/conveyance cost	☐	☐	☐	☐	☐
	Profit per month (after all expenses)	☐	☐	☐	☐	☐
	Return on investment (ROI)	☐	☐	☐	☐	☐
Flexibility	Delivery flexibility (coping with time)	☐	☐	☐	☐	☐
	Volume flexibility (volume of milk)	☐	☐	☐	☐	☐
Responsiveness	Fill rate (target upon actual)	☐	☐	☐	☐	☐
	Customer (society) complaints	☐	☐	☐	☐	☐
Product quality	Safety of milk produced	☐	☐	☐	☐	☐
	Product reliability (consistency TMS)	☐	☐	☐	☐	☐
Process quality	Working conditions in production	☐	☐	☐	☐	☐
	Chemical/energy/water use	☐	☐	☐	☐	☐
Overall performance in milk production and sales		☐	☐	☐	☐	☐

24. Suggestions to improve the cooperative based dairying sector:

Thanking you so much for your time and support

<u>APPENDIX A2</u>

PRAMOD KUMAR MISHRA **SCHOOL OF MANAGEMENT STUDIES**

DOCTORAL RESEARCHER **UNIVERSITY OF HYDERABAD**

HYDERABAD

QUESTIONNAIRE FOR THE DAIRY COOPERATIVE SOCIETIES

Purpose of the study: <u>The questionnaire is designed to collect data to be purely used for the Doctoral Research purpose. The data provided by you will be kept as top secret and under any circumstances won't be revealed to any individual or organisation.</u>

Instructions: <u>Please tick the appropriate boxes and give necessary information wherever required.</u>

1. Name of the society:

Name of the society	

2. Contact person's details:

Name	
Village	
Tehsil	
District	
Phone	

3. Gender:

Male	☐	Female	☐

4. Age:

Age (years)	

5. Education:

Illiterate	☐	Read and write	☐
Primary	☐	High School	☐
College	☐	Any other (please specify):	

6. The reason behind society formulation:

High marketable surplus of milk	☐	Union/federation initiative	☐

Easy availability of veterinary service	☐	Influencing village leader	☐
Any other (please specify)			

7. Society status:

Year of inception		No. of milching animals covered	
Year of registration		No. of male members	
Total assets (Rs.)		No. of female members	
No. of revenue villages covered		No. of pouring members	
Operational area (sq. kms)		Membership charges (Rs.)	
Population covered in the area		Distance from chilling centre (kms)	
No. of milk producers covered		Distance from the chilling (kms)	

8. Members' waiting time to deliver milk:

Av. waiting time of a member on the queues to deliver his/her produce (minutes)	

9. Amount of milk collections:

Milk collections per day	September to February	March to August	Yearly average

10. Target vs. actual milk collections:

Target collections per day (litres)		Actual collections per day (litres)	

11. Demand of the union fulfilled:

Average number of days the demand of the union/target is fulfilled in a year	

12. Solid contents and price for milk collected:

Fat (percent)		Solid-not-fat (percent)	
Average price paid to a member producer per litre of milk (Rs)			

13. Distribution of cost and income per month:

Particulars	Rs.	Particulars	Rs.
House rent/infrastructural costs		Penalty (if any)	
Electricity costs		Profit (fodder & medicines)	
Misc. expenses (interests etc.)		Grant-in-aid (if any)	

14. Supply chain risk issues:

Supply chain risk factors	Frequency/likelihood					Severity				
	Very low	Low	Neither high nor low	High	Very high	Insignificant	Minor	Neither serious nor minor	Serious	Catastrophic
Delivery risk to chilling cent.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Financial risks and hardships	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Illiteracy of producers	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Intense competition	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lack of coop. & info. sharing	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lack of leadership skills of the secretary	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Low level of milk collection	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Low profit margin	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Non-remunerative price	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Penalty risks	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Any other:	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Collection and transportation of milk is a riskier affair	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

15. Risk management in the organisation (please comment about approaching problems):

16. Supply chain coordination issues:

Perceptions towards supply chain coordination	Strongly disagree	Disagree	Indifferent	Agree	Strongly agree
Insufficient internal resources is a barrier to communication	☐	☐	☐	☐	☐
Forecasting should be done and shared with the union and federation regarding collections	☐	☐	☐	☐	☐
Closely working with the union/federation authorities is highly essential	☐	☐	☐	☐	☐

Trusting each other and believing in long term relationship	☐	☐	☐	☐	☐
Stakeholders should work hard to maintain it	☐	☐	☐	☐	☐
Hesitation in collecting and disseminating information	☐	☐	☐	☐	☐
Sharing responsibilities will help improving the sector	☐	☐	☐	☐	☐
Lack of cooperation among stakeholders is an obstacle	☐	☐	☐	☐	☐
Difficult to assess material benefits of long term relationships	☐	☐	☐	☐	☐
Overall coordination among stakeholders is highly essential	☐	☐	☐	☐	☐

17. Supply chain performance issues:

Supply chain indicators	Supply chain sub-indicators	Very low	Low	Neither high nor low	High	Very high
Efficiency	Facilities costs (collection cost)	☐	☐	☐	☐	☐
	Transportation costs	☐	☐	☐	☐	☐
	Net profit after all expenses	☐	☐	☐	☐	☐
	Return on investment	☐	☐	☐	☐	☐
Flexibility	Customer (chilling centres) satisfaction	☐	☐	☐	☐	☐
	Delivery flexibility (timely delivery)	☐	☐	☐	☐	☐
	Volume flexibility (capacity to deliver more)	☐	☐	☐	☐	☐
Responsiveness	Fill rate (target upon actual)	☐	☐	☐	☐	☐
	Customer (chilling centre) complaints	☐	☐	☐	☐	☐
Product quality	Product safety	☐	☐	☐	☐	☐
	Product reliability (consistency in TMS)	☐	☐	☐	☐	☐
Process quality	Storage and transport conditions	☐	☐	☐	☐	☐
	Working conditions	☐	☐	☐	☐	☐
Overall performance in milk collection and delivery		☐	☐	☐	☐	☐

18. Suggestions to improve cooperative based dairying sector:

Thanking you so much for your time and support

APPENDIX A3

PRAMOD KUMAR MISHRA **SCHOOL OF MANAGEMENT STUDIES**

DOCTORAL RESEARCHER **UNIVERSITY OF HYDERABAD**

HYDERABAD

QUESTIONNAIRE FOR THE BULK MILK COOLERS

Purpose of the study: The questionnaire is designed to collect data to be purely used for the Doctoral Research purpose. The data provided by you will be kept as top secret and under any circumstances won't be revealed to any individual or organisation.

Instructions: Please tick the appropriate boxes and give necessary information wherever required.

1. Name of the bulk milk cooler:

Name of the bulk milk cooler	

2. Contact person's details:

Name	
Village	
Tehsil	
District	
Phone	
E-mail	
Designation	
Responsibilities	

3. Bulk milk cooler operational summary:

Years of operation in the sector		Number of societies covered	
Name of the funding project		Av. distance from the societies (kms)	
Infrastructural status (own/rented)		Total number of producer members	
Infrastructural costs (if own)		Av. milk procured/day in flush seasons (litres)	
Machineries and equipment cost		Av. milk procured/day in lean seasons (litres)	

Capacity of the plant (litres)		Av. yearly milk procurement per day	
Total assets (Rs.)		Fat content of the milk procured (percent)	
No. of regular employees		Solid-not-fat content of the milk procured (percent)	
No. of contractual employees		Av. no of days target is fulfilled in a year	
Distance from the production plant (kms)		Av. machine running time/day (hours)	
Operational area (sq. kms)		Av. machine downtime/day (hours)	

4. Distribution of cost and income per month:

Particulars	Rs.	Particulars	Rs.
House rent/infrastructural costs		Head loader charges	
Electricity costs		Misc. expenses (interests/tax etc.)	
Transportation costs		Penalty (if any)	
Maintenance costs		Profit from sales	
Plant-in-charge salary		Profit (fodder & medicines)	
Secretary commissions		Grant-in-aid (if any)	

5. Supply chain risk issues:

Supply chain risk factors	Frequency/likelihood					Severity				
	Very low	Low	Neither high nor low	High	Very high	Insignificant	Minor	Neither serious nor minor	Serious	Catastrophic
Delivery risk to the production plant										
Down time due to machine failure										
Financial risks and hardships										
Fuel and energy price volatility										
Hazard risks (fire, sabotage etc.)										
Intense competition										
Lack of cooperation and info. sharing										

Low level of milk procurement	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Penalty related risks	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Poor quality of milk procured	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Seasonal fluctuations in procurement	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Transportation risks	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Unavailability of skilled workforce	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Wastage during transit	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Any other:	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Overall risk perceptions procurement, chilling and transportation	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

6. Risk management in the organisation (please comment about approaching problems):

7. Supply chain coordination issues:

Perceptions towards supply chain coordination	Strongly disagree	Disagree	Indifferent	Agree	Strongly agree
Insufficient internal resources is a barrier to communication	☐	☐	☐	☐	☐
Forecasting should be done and shared with the federation/ plant regarding collections	☐	☐	☐	☐	☐
Closely working with the stakeholders both upstream and downstream is highly essential	☐	☐	☐	☐	☐
Trusting each other and believing in long term relationship	☐	☐	☐	☐	☐
Stakeholders should work hard to maintain long term relationships	☐	☐	☐	☐	☐
Hesitation in collecting and disseminating information	☐	☐	☐	☐	☐
Sharing responsibilities will help improving the sector	☐	☐	☐	☐	☐
Lack of cooperation among stakeholders is an obstacle	☐	☐	☐	☐	☐
Difficult to assess material benefits of long term relationships	☐	☐	☐	☐	☐
Overall coordination among stakeholders is highly essential	☐	☐	☐	☐	☐

8. Supply chain performance issues:

Supply chain indicators	Supply chain sub-indicators	Very low	Low	Neither high nor low	High	Very high
Efficiency	Facilities costs (cost of collection/chilling)	☐	☐	☐	☐	☐
	Transportation cost	☐	☐	☐	☐	☐
	Inventory cost	☐	☐	☐	☐	☐
	Net profit after all expenses	☐	☐	☐	☐	☐
	Return on investment	☐	☐	☐	☐	☐
Flexibility	Customer (production plant) satisfaction	☐	☐	☐	☐	☐
	Delivery flexibility (timely delivery)	☐	☐	☐	☐	☐
	Volume flexibility (capacity to deliver more)	☐	☐	☐	☐	☐
Responsiveness	Fill rate (target upon actual)	☐	☐	☐	☐	☐
	Customer response time	☐	☐	☐	☐	☐
	Customer (production plant) complaints	☐	☐	☐	☐	☐
Product quality	Product shelf life	☐	☐	☐	☐	☐
	Product safety	☐	☐	☐	☐	☐
	Product reliability (consistency in TMS)	☐	☐	☐	☐	☐
Process quality	Traceability (whereabouts of the logistics)	☐	☐	☐	☐	☐
	Storage and transport conditions	☐	☐	☐	☐	☐
	Working conditions in the process	☐	☐	☐	☐	☐
	Chemical use in milk processing	☐	☐	☐	☐	☐
	Energy use in milk processing	☐	☐	☐	☐	☐
	Water use in milk and processing	☐	☐	☐	☐	☐
Overall performance in milk procurement, chilling and delivery		☐	☐	☐	☐	☐

9. Suggestions to improve cooperative based dairying sector:

Thanking you so much for your time and support

APPENDIX A4

PRAMOD KUMAR MISHRA **SCHOOL OF MANAGEMENT STUDIES**

DOCTORAL RESEARCHER **UNIVERSITY OF HYDERABAD**

HYDERABAD

QUESTIONNAIRE FOR THE PRODUCTION PLANT OFFICIALS

Purpose of the study: The questionnaire is designed to collect data to be purely used for the Doctoral Research purpose. The data provided by you will be kept as top secret and under any circumstances won't be revealed to any individual or organisation.

Instructions: Please tick the appropriate boxes and give necessary information wherever required.

1. Contact person's details:

Name	
City	
District	
Phone	
E-mail	
Designation	
Responsibilities	

2. Production plant operational summary:

Years of operation		Av. downtime/month (hours)	
Name of the funding agencies		Av. amount of milk processed/ day (litres)	
Total assets of the plant (Rs.)		Operational area of the plant (sq kms)	
Number of regular employees		Total number of retailers	
Number of contractual employees		Sales/month (Rs.)	
Processing capacity of the plant (litres)		Market share (percent)	
Av. machine running time/day (hours)		Sales growth (percent)	

3. Supply chain cycle times and fill rates:

Various cycles	Cycle time (hours)	Various fill rates	Fill rates (percent)
Procurement		Product fill rate	
Manufacturing		Order fill rate	
Replenishment		Demand unfulfilled/opportunity loss	

4. Supply chain risk issues:

Supply chain risk factors	Frequency/likelihood					Severity				
	Very low	Low	Neither high nor low	High	Very high	Insignificant	Minor	Neither serious nor minor	Serious	Catastrophic
Capacity constraints	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Communication distortions	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Damage and spillage during transit	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Demand unpredictability	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Financial risks and hardships	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Forecasting errors	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Hazard risks (fire, sabotage etc.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Human related risks	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Increasing product variety	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Inefficiency in managing inventory	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Intellectual property risk	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Intense competition	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lack of coordination among the stakeholders	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Logistical risks	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Low profit margin	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Political and legal risks	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Process/control/quality risks	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Product wastage/perishability	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Seasonal fluctuations in procurement/marketing	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Supplier unreliability	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Volatility in energy/fuel prices	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Any other:	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Overall risk perceptions of dairy production and sales	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

5. Risk management in the organisation (please comment about approaching problems):

6. Supply chain coordination issues:

Perceptions towards supply chain coordination	Strongly disagree	Disagree	Indifferent	Agree	Strongly agree
Insufficient internal resources is a barrier to communication	☐	☐	☐	☐	☐
Forecasting should be done and shared with the federation regarding procurement, processing and distribution	☐	☐	☐	☐	☐
Closely working with the stakeholders both upstream and downstream is highly essential	☐	☐	☐	☐	☐
Trusting each other and believing in long term relationship	☐	☐	☐	☐	☐
Stakeholders should work hard to maintain long term relationships	☐	☐	☐	☐	☐
Hesitation in collecting and disseminating information	☐	☐	☐	☐	☐
Sharing responsibilities will help improving the sector	☐	☐	☐	☐	☐
Lack of cooperation among stakeholders is an obstacle	☐	☐	☐	☐	☐
Difficult to assess material benefits of long term relationships	☐	☐	☐	☐	☐
Overall coordination among stakeholders is highly essential	☐	☐	☐	☐	☐

7. Supply chain performance issues:

Supply chain indicators	Supply chain sub-indicators	Very low	Low	Neither high nor low	High	Very high
Efficiency	Facilities costs (production cost)	☐	☐	☐	☐	☐
	Inventory cost	☐	☐	☐	☐	☐
	Logistics costs	☐	☐	☐	☐	☐
	Profit after all expenses	☐	☐	☐	☐	☐
	Return on investment	☐	☐	☐	☐	☐
Flexibility	Customer (consumer) satisfaction	☐	☐	☐	☐	☐
	Delivery flexibility	☐	☐	☐	☐	☐
	Volume flexibility	☐	☐	☐	☐	☐
	Backorders	☐	☐	☐	☐	☐
	Lost sales	☐	☐	☐	☐	☐
Responsiveness	Fill rate (target upon actual)	☐	☐	☐	☐	☐
	Product lateness	☐	☐	☐	☐	☐
	Customer response time	☐	☐	☐	☐	☐
	Lead time	☐	☐	☐	☐	☐
	Customer complaints	☐	☐	☐	☐	☐
Product quality	Product appearance	☐	☐	☐	☐	☐
	Product taste	☐	☐	☐	☐	☐
	Shelf life	☐	☐	☐	☐	☐
	Safety	☐	☐	☐	☐	☐
	Product reliability (consistency in quality)	☐	☐	☐	☐	☐
Process quality	Traceability (whereabouts of the logistics)	☐	☐	☐	☐	☐
	Storage and transporting conditions	☐	☐	☐	☐	☐
	Working conditions in the process	☐	☐	☐	☐	☐
	Chemical use in milk processing	☐	☐	☐	☐	☐
	Energy use in milk processing	☐	☐	☐	☐	☐
	Water use in milk and processing	☐	☐	☐	☐	☐
	Sales promotions	☐	☐	☐	☐	☐
	Customer (retailer/consumer) service	☐	☐	☐	☐	☐
Overall performance in production and distribution		☐	☐	☐	☐	☐

8. Suggestions to improve cooperative based dairying sector:

Thanking you so much for your time and support

APPENDIX A5

PRAMOD KUMAR MISHRA **SCHOOL OF MANAGEMENT STUDIES**

DOCTORAL RESEARCHER **UNIVERSITY OF HYDERABAD**

HYDERABAD

QUESTIONNAIRE FOR THE TRANSPORTING AGENCIES (TPLPS)

Purpose of the study: The questionnaire is designed to collect data to be purely used for the Doctoral Research purpose. The data provided by you will be kept as top secret and under any circumstances won't be revealed to any individual or organisation.

Instructions: Please tick the appropriate boxes and give necessary information wherever required.

1. Contact person's details:

Name	
City	
District	
Phone	
E-mail	
Designation	
Responsibilities	

2. Transporting agency operational summary:

Particulars of transporting operations	Units	Figures
Years of operation with the company	Years	
Company owned vehicles	Nos	
Leased/hired vehicles	Nos	
Insulated vehicles	Nos	
Total assets of the company	Rs.	
Regular employees	Nos	
Contractual employees	Nos	
Routes covered during distribution	Nos	
Distance travelled during distribution per day	Kms	
Av. amount of milk transported per day	Litres	

Av. worth of product transported per day	Rs.	
Av. amount of milk (product) wastage per day	Rs.	

3. Operating costs and receipts:

Particulars	Rs./month	Particulars	Rs./month
Fuel cost		Quantity related cost	
Maintenance cost		Salary paid to staff	
Fixed operating cost		Overhead costs	
Trip related cost		Total receipts	

4. Supply chain risk issues:

Supply chain risk factors	Frequency/likelihood					Severity				
	Very low	Low	Neither high nor low	High	Very high	Insignificant	Minor	Neither serious nor minor	Serious	Catastrophic
Capacity constraints	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Communication distortions	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Damage and spillage during transit	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Delivery risks to retailers	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Difficulty in network selection	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Financial risks and hardships	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Hazard risks (fire, sabotage etc.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Intense competition	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lack of coop. & info. sharing	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Low profit margin	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Penalty risk	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Perishability of milk	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Transportation risks	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Unavailability of skilled workforce	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Volatility in fuel prices	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Any other:	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Overall risk perceptions	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

5. Risk management in the organisation (please comment about approaching problems):

6. Supply chain coordination issues:

Perceptions towards supply chain coordination	Strongly disagree	Disagree	Indifferent	Agree	Strongly agree
Insufficient internal resources is a barrier to communication	☐	☐	☐	☐	☐
Forecasting should be done and shared with the federation/ plant regarding collections	☐	☐	☐	☐	☐
Closely working with the production plant is highly essential	☐	☐	☐	☐	☐
Trusting each other and believing in long term relationship	☐	☐	☐	☐	☐
Stakeholders should work hard to maintain long term relationships	☐	☐	☐	☐	☐
Hesitation in collecting and disseminating information	☐	☐	☐	☐	☐
Sharing responsibilities will help improving the sector	☐	☐	☐	☐	☐
Lack of cooperation among stakeholders is an obstacle	☐	☐	☐	☐	☐
Difficult to assess material benefits of long term relationships	☐	☐	☐	☐	☐
Overall coordination among stakeholders is highly essential	☐	☐	☐	☐	☐

7. Supply chain performance issues:

Supply chain indicators	Supply chain sub-indicators	Very low	Low	Neither high nor low	High	Very high
Efficiency	Facilities costs (operating costs)	☐	☐	☐	☐	☐
	Transportation costs	☐	☐	☐	☐	☐
	Profit after all expenses	☐	☐	☐	☐	☐
	Return on investment	☐	☐	☐	☐	☐
Flexibility	Customer (plant/retailers) satisfaction	☐	☐	☐	☐	☐
	Delivery flexibility (timely delivery)	☐	☐	☐	☐	☐

	Volume flexibility (handling capacity)	☐	☐	☐	☐	☐
Responsiveness	Customer response time	☐	☐	☐	☐	☐
	Customer (plant/retailers) complaints	☐	☐	☐	☐	☐
	Shipping errors (wrong delivery)	☐	☐	☐	☐	☐
Product quality	Safety during transit	☐	☐	☐	☐	☐
	Product reliability (no malpractices)	☐	☐	☐	☐	☐
Process quality	Traceability (whereabouts of the logistics)	☐	☐	☐	☐	☐
	Storage and transporting conditions	☐	☐	☐	☐	☐
	Energy/fuel use during transportation	☐	☐	☐	☐	☐
	Customer (plant/retailers) service	☐	☐	☐	☐	☐
Overall performance in transportation and delivery		☐	☐	☐	☐	☐

8. Suggestions to improve cooperative based dairying sector:

Thanking you so much for your time and support

APPENDIX A6

PRAMOD KUMAR MISHRA — **SCHOOL OF MANAGEMENT STUDIES**

DOCTORAL RESEARCHER — **UNIVERSITY OF HYDERABAD**

HYDERABAD

QUESTIONNAIRE FOR THE RETAIL OUTLETS

Purpose of the study: The questionnaire is designed to collect data to be purely used for the Doctoral Research purpose. The data provided by you will be kept as top secret and under any circumstances won't be revealed to any individual or organisation.

Instructions: Please tick the appropriate boxes and give necessary information wherever required.

1. Contact person's details:

Name	
Tehsil	
District	
Phone	
E-mail	

2. Gender:

Male	☐	Female	☐

3. Age:

Age (years)	

4. Education:

Illiterate	☐	Read and write	☐
Primary	☐	High School	☐
College	☐	Any other (please specify):	

5. Reason for retailing the brand:

High demand	☐	High profit margin	☐
Low investment	☐	Business expansion	☐
Brand image	☐	Way of self-employment	☐

6. Retailer summary and distribution of expenses:

Years with the company		Promotional milk received per day (lt)	
Total number of outlets owned		House rent/investments for house (Rs.)	
Distance from the plant (kms)		Electricity charges/month (Rs.)	
Operational area (sq kms)		Wages/month (Rs.)	
Total investments (Rs.)		Interests/month (Rs.)	
Av. milk ordered per day (lts)		Overheads/month (Rs.)	

7. Sales of various products with usual units:

Products	Unit	Sales (Qty)	Amount (Rs.)	PFR (percent)
Packaged milk				
Home delivery (milk)				
Sweetened curd				
Whole milk curd				
Paneer				
Chhenapoda				
Khira				
Butter milk				
Flavoured milk				
Ghee				
Others:				

8. Supply chain risk issues:

Supply chain risk factors	Frequency/likelihood					Severity				
	Very low	Low	Neither high nor low	High	Very high	Insignificant	Minor	Neither serious nor minor	Serious	Catastrophic
Changing customers	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Delay in delivery	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Demand fluctuations	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Financial risks and hardships	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Inefficiency in managing inventory	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Intense competition	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Interruption in supply	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lack of coop. & info. sharing	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Product shortages	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Receiving leaked or damaged products	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Seasonal fluctuations in product availability	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Supplier unreliability	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Any other:	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Overall risk perceptions of retailing milk and dairy products	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

9. Risk management in retailing (please comment about approaching problems):

10. Supply chain coordination issues:

Perceptions towards supply chain coordination	Strongly disagree	Disagree	Indifferent	Agree	Strongly agree
Insufficient internal resources is a barrier to communication	☐	☐	☐	☐	☐
Forecasting should be done and shared with the federation/ plant regarding sales and future demands	☐	☐	☐	☐	☐
Closely working with the stakeholders both upstream (customers) and downstream is highly essential	☐	☐	☐	☐	☐
Trusting each other and believing in long term relationship	☐	☐	☐	☐	☐
Stakeholders should work hard to maintain long term relationships	☐	☐	☐	☐	☐
Hesitation in collecting and disseminating information	☐	☐	☐	☐	☐
Sharing responsibilities will help improving the sector	☐	☐	☐	☐	☐

Lack of cooperation among stakeholders is an obstacle	☐	☐	☐	☐	☐
Difficult to assess material benefits of long term relationships	☐	☐	☐	☐	☐
Overall coordination among stakeholders is highly essential	☐	☐	☐	☐	☐

11. Supply chain performance issues:

Supply chain indicators	Supply chain sub-indicators	Very low	Low	Neither high nor low	High	Very high
Efficiency	Facilities costs (costs of selling)	☐	☐	☐	☐	☐
	Inventory cost (storing costs)	☐	☐	☐	☐	☐
	Transportation cost (home delivery)	☐	☐	☐	☐	☐
	Profit after all expenses	☐	☐	☐	☐	☐
	Return on investment	☐	☐	☐	☐	☐
Flexibility	Customer satisfaction	☐	☐	☐	☐	☐
	Volume flexibility (able to handle more milk to satisfy demand)	☐	☐	☐	☐	☐
	Lost sales due to product unavailability	☐	☐	☐	☐	☐
Responsiveness	Fill rate (demand fulfilled)	☐	☐	☐	☐	☐
	Customer response time	☐	☐	☐	☐	☐
	Customer complaints	☐	☐	☐	☐	☐
Product quality	Product shelf life	☐	☐	☐	☐	☐
	Product safety	☐	☐	☐	☐	☐
	Product reliability (dependability of customers on retailers)	☐	☐	☐	☐	☐
Process quality	Promoting sales (on behalf of plant)	☐	☐	☐	☐	☐
	Display in stores (to attract customers)	☐	☐	☐	☐	☐
	Customer service	☐	☐	☐	☐	☐
Overall performance of retailing to meet customers' demand		☐	☐	☐	☐	☐

12. Suggestions to improve cooperative based dairying sector:

Thanking you so much for your time and support

APPENDIX A7

PRAMOD KUMAR MISHRA **SCHOOL OF MANAGEMENT STUDIES**

DOCTORAL RESEARCHER **UNIVERSITY OF HYDERABAD**

HYDERABAD

QUESTIONNAIRE FOR THE CUSTOMERS

Purpose of the study: The questionnaire is designed to collect data to be purely used for the Doctoral Research purpose. The data provided by you will be kept as top secret and under any circumstances won't be revealed to any individual or organisation.

Instructions: Please tick the appropriate boxes and give necessary information wherever required.

1. Contact person's details:

Name	
Tehsil/City	
District	
Phone/E-mail	

2. Gender:

Male	☐	Female	☐

3. Age:

Age (years)	

4. Education:

Illiterate	☐	Read and write	☐
Primary	☐	High School	☐
College	☐	Any other (please specify):	

5. Occupation:

Service (Pvt/Govt)	☐	Professional	☐
Business/Trade	☐	Others (please specify)	

6. Monthly income:

Monthly income (Rs.)	

7. Size of the family:

Size of the family (nos)	

8. Mode of purchasing packaged milk:

Counter purchase	☐	Home delivery	☐

9. Expenses on milk and dairy products:

Average amount of milk purchased per day (lts)		Average expenditure on dairy products per month (Rs.)	

10. Percentage of income expenditure on dairy products:

Income expenditure on dairy products (percent)	

11. Reason for favouring the brand:

Retailer accessibility	☐	Product safety	☐
Product availability	☐	Reasonable price	☐
Product quality	☐	Any other (please mention)	

12. Perceptions towards price rise of milk and its derivative:

Price does not impact on buying	☐	Stopping consumption	☐
Switching over to a different brand	☐	Consumption level will come down	☐
Any other (please specify):			

13. Supply chain risk issues:

Supply chain risk factors	Frequency/likelihood					Severity				
	Very low	Low	Neither high nor low	High	Very high	Insignificant	Minor	Neither serious nor minor	Serious	Catastrophic
Incompatible price w.r.t product quality	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lack of product quality	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lack of product reliability	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lack of product safety	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Unreliable retailers	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Unresponsiveness towards complaints										
Any other:										
Overall risk perceptions of product purchase and consumptions										

14. Supply chain performance:

Supply chain indicators	Supply chain sub-indicators	Very low	Low	Neither high nor low	High	Very high
Product performance	Availability of the product					
	Compatibility of price with the product worth					
	Appearance of the product					
	Taste of the product					
	Shelf life/freshness of the product					
	Safety of the product					
	Product reliability					
	Product certification performance					
	Overall product traits (fit for consumption)					
Retailer performance	Accessibility of the retailers					
	Home delivery					
	On time/speed delivery					
	Prioritising the loyal customers					
	Consistency in service					
	Mutual trust between seller and buyer					
	Smooth flow of material/information					
	Facilitate communication					
	Overall retailers' performance in sales					
Federation/ company performance	Understanding of customer needs					
	Responsiveness towards customer complaints					
	Customer centric vision					
Overall brand performance in meeting customers' expectations						

15. Suggestions to improve the cooperative based dairying sector:

Thank you so much for your time and support

APPENDIX A9

PAPERS PUBLISHED IN PEER REVIEWED JOURNALS

1. Mishra, P. K., & Raja Shekhar, B. (2010). Supply chain performance under risk environment: An empirical study on Indian dairy industry. *European Journal of Management, 10*(3), 138-146.

2. Mishra, P. K., & Raja Shekhar, B. (2010). Measuring quality of service in retail outlets using fuzzy numbers. *Management Science and Engineering, 4*(3), 80-86.

3. Mishra, P. K., & Raja Shekhar, B. (2011). Impact of risks and uncertainties on supply chain: A dairy industry perspective. *Journal of Management Research, 3*(2), E11.

PAPERS PUBLISHED IN CONFERENCE PROCEEDINGS

1. Mishra, P. K., & Raja Shekhar, B. (2007). Evaluation of TQM practices in technical education in India. *AIMS (Texas) International Conference, IBS, Hyderabad, India*, December 27 - 30.

2. Mishra, P. K., & Raja Shekhar, B. (2007). Measuring quality of service in retail outlets using fuzzy numbers. *International Conference on Retailing in the Globalised Era-Perspectives & Challenges, University of Hyderabad, India*, December 28 – 30.

3. Mishra, P. K., & Raja Shekhar, B. (2009). Evaluation of supply chain management practices in Indian dairy industry. *International Symposium and Workshop on GSCM (PSGIM & Univ. of Toledo), PSGIM, Coimbatore, India*, January 6 – 7.

4. Mishra, P. K., & Raja Shekhar, B. (2010). Supply chain performance under risk environment: An empirical study on Indian dairy industry. *International Conference on Business and Economics (IABE), Las Vegas, USA*, October 17 - 20.